

K^\pm

$$I(J^P) = \frac{1}{2}(0^-)$$

A REVIEW GOES HERE – Check our WWW List of Reviews

K^\pm MASS

VALUE (MeV)	DOCUMENT ID	TECN	CHG	COMMENT
-------------	-------------	------	-----	---------

493.677±0.016 OUR FIT Error includes scale factor of 2.8.

493.677±0.013 OUR AVERAGE Error includes scale factor of 2.4. See the ideogram below.

493.696±0.007	¹ DENISOV	91	CNTR	—	Kaonic atoms
493.636±0.011	² GALL	88	CNTR	—	Kaonic atoms
493.640±0.054	LUM	81	CNTR	—	Kaonic atoms
493.670±0.029	BARKOV	79	EMUL	±	$e^+ e^- \rightarrow K^+ K^-$
493.657±0.020	² CHENG	75	CNTR	—	Kaonic atoms
493.691±0.040	BACKENSTO...73	CNTR	—	—	Kaonic atoms

• • • We do not use the following data for averages, fits, limits, etc. • • •

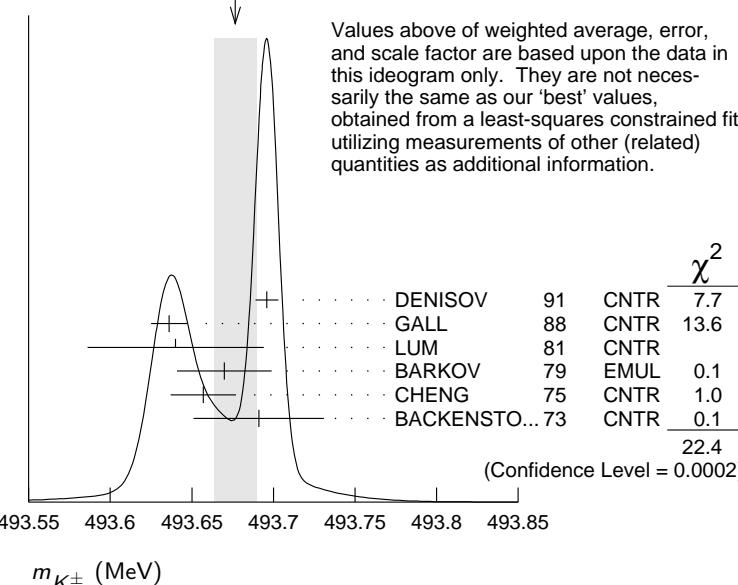
493.631±0.007	GALL	88	CNTR	—	$K^- Pb (9 \rightarrow 8)$
493.675±0.026	GALL	88	CNTR	—	$K^- Pb (11 \rightarrow 10)$
493.709±0.073	GALL	88	CNTR	—	$K^- W (9 \rightarrow 8)$
493.806±0.095	GALL	88	CNTR	—	$K^- W (11 \rightarrow 10)$
493.640±0.022±0.008	³ CHENG	75	CNTR	—	$K^- Pb (9 \rightarrow 8)$
493.658±0.019±0.012	³ CHENG	75	CNTR	—	$K^- Pb (10 \rightarrow 9)$
493.638±0.035±0.016	³ CHENG	75	CNTR	—	$K^- Pb (11 \rightarrow 10)$
493.753±0.042±0.021	³ CHENG	75	CNTR	—	$K^- Pb (12 \rightarrow 11)$
493.742±0.081±0.027	³ CHENG	75	CNTR	—	$K^- Pb (13 \rightarrow 12)$

1 Error increased from 0.0059 based on the error analysis in IVANOV 92.

2 This value is the authors' combination of all of the separate transitions listed for this paper.

3 The CHENG 75 values for separate transitions were calculated from their Table 7 transition energies. The first error includes a 20% systematic error in the noncircular contaminant shift. The second error is due to a ± 5 eV uncertainty in the theoretical transition energies.

WEIGHTED AVERAGE
493.677±0.013 (Error scaled by 2.4)



$m_{K^+} - m_{K^-}$

Test of CPT.

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	CHG
-0.032±0.090	1.5M	⁴ FORD	72	ASPK ±

NODE=S010203

NODE=S010M

NODE=S010M

OCCUR=2

OCCUR=3

OCCUR=4

OCCUR=5

OCCUR=2

OCCUR=3

OCCUR=4

OCCUR=5

OCCUR=6

NODE=S010M;LINKAGE=BB

NODE=S010M;LINKAGE=AA

NODE=S010M;LINKAGE=CC

NODE=S010DM

NODE=S010DM

NODE=S010DM

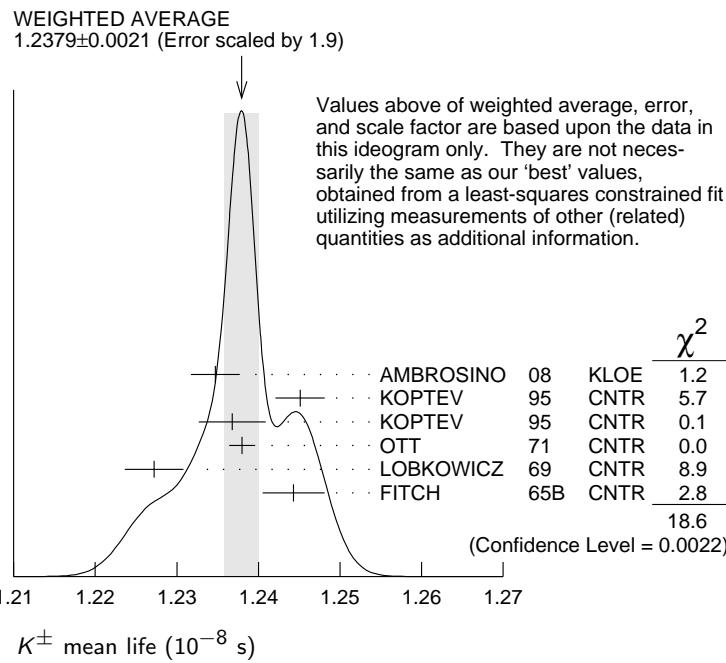
⁴FORD 72 uses $m_{\pi^+} - m_{\pi^-} = +28 \pm 70$ keV.

K^\pm MEAN LIFE

VALUE (10^{-8} s)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
1.2380±0.0021 OUR FIT					Error includes scale factor of 1.9.
1.2379±0.0021 OUR AVERAGE					Error includes scale factor of 1.9. See the ideogram below.
1.2347±0.0030	15M	⁵ AMBROSINO	08	KLOE	\pm $\phi \rightarrow K^+ K^-$
1.2451±0.0030	250k	KOPTEV	95	CNTR	K at rest, U target
1.2368±0.0041	150k	KOPTEV	95	CNTR	K at rest, Cu target
1.2380±0.0016	3M	OTT	71	CNTR	K at rest
1.2272±0.0036		LOBKOWICZ	69	CNTR	K in flight
1.2443±0.0038		FITCH	65B	CNTR	K at rest
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.2415±0.0024	400k	⁶ KOPTEV	95	CNTR	K at rest
1.221 ± 0.011		FORD	67	CNTR	\pm
1.231 ± 0.011		BOYARSKI	62	CNTR	$+$

⁵ Result obtained by averaging the decay length and decay time analyses taking correlations into account.

⁶ KOPTEV 95 report this weighted average of their U-target and Cu-target results, where they have weighted by $1/\sigma$ rather than $1/\sigma^2$.



$$(\tau_{K^+} - \tau_{K^-}) / \tau_{\text{average}}$$

This quantity is a measure of *CPT* invariance in weak interactions.

VALUE (%)	DOCUMENT ID	TECN
0.10 ±0.09 OUR AVERAGE		Error includes scale factor of 1.2.
-0.4 ± 0.4	AMBROSINO	08 KLOE
0.090±0.078	LOBKOWICZ	69 CNTR
0.47 ± 0.30	FORD	67 CNTR

A REVIEW GOES HERE – Check our WWW List of Reviews

K^+ DECAY MODES

K^- modes are charge conjugates of the modes below.

Mode	Fraction (Γ_i/Γ)	Scale factor/ Confidence level

NODE=S010DM;LINKAGE=F

NODE=S010T

NODE=S010T

OCCUR=2

OCCUR=3

NODE=S010T;LINKAGE=AM

NODE=S010T;LINKAGE=A

NODE=S010DT

NODE=S010DT

NODE=S010DT

NODE=S010223

NODE=S010225;NODE=S010

NODE=S010

Leptonic and semileptonic modes					
Γ_1	$e^+ \nu_e$		$(1.581 \pm 0.008) \times 10^{-5}$		NODE=S010;CLUMP=A DESIG=11
Γ_2	$\mu^+ \nu_\mu$		$(63.55 \pm 0.11) \%$	S=1.2	DESIG=1
Γ_3	$\pi^0 e^+ \nu_e$ Called K_{e3}^+ .		$(5.07 \pm 0.04) \%$	S=2.1	DESIG=6
Γ_4	$\pi^0 \mu^+ \nu_\mu$ Called $K_{\mu 3}^+$.		$(3.353 \pm 0.034) \%$	S=1.8	DESIG=5
Γ_5	$\pi^0 \pi^0 e^+ \nu_e$		$(2.2 \pm 0.4) \times 10^{-5}$		DESIG=24
Γ_6	$\pi^+ \pi^- e^+ \nu_e$		$(4.254 \pm 0.032) \times 10^{-5}$		DESIG=7
Γ_7	$\pi^+ \pi^- \mu^+ \nu_\mu$		$(1.4 \pm 0.9) \times 10^{-5}$		DESIG=9
Γ_8	$\pi^0 \pi^0 \pi^0 e^+ \nu_e$	<	3.5×10^{-6}	CL=90%	DESIG=44
Hadronic modes					
Γ_9	$\pi^+ \pi^0$		$(20.66 \pm 0.08) \%$	S=1.2	NODE=S010;CLUMP=B DESIG=2
Γ_{10}	$\pi^+ \pi^0 \pi^0$		$(1.761 \pm 0.022) \%$	S=1.1	DESIG=4
Γ_{11}	$\pi^+ \pi^+ \pi^-$		$(5.59 \pm 0.04) \%$	S=1.3	DESIG=3
Leptonic and semileptonic modes with photons					
Γ_{12}	$\mu^+ \nu_\mu \gamma$	[a,b]	$(6.2 \pm 0.8) \times 10^{-3}$		NODE=S010;CLUMP=C DESIG=12
Γ_{13}	$\mu^+ \nu_\mu \gamma (\text{SD}^+)$	[c,d]	$(1.33 \pm 0.22) \times 10^{-5}$		DESIG=39
Γ_{14}	$\mu^+ \nu_\mu \gamma (\text{SD}^+ \text{INT})$	[c,d]	< 2.7 $\times 10^{-5}$	CL=90%	DESIG=81
Γ_{15}	$\mu^+ \nu_\mu \gamma (\text{SD}^- + \text{SD}^- \text{INT})$	[c,d]	< 2.6 $\times 10^{-4}$	CL=90%	DESIG=40
Γ_{16}	$e^+ \nu_e \gamma$		$(9.4 \pm 0.4) \times 10^{-6}$		DESIG=21
Γ_{17}	$\pi^0 e^+ \nu_e \gamma$	[a,b]	$(2.56 \pm 0.16) \times 10^{-4}$		DESIG=18
Γ_{18}	$\pi^0 e^+ \nu_e \gamma (\text{SD})$	[c,d]	< 5.3 $\times 10^{-5}$	CL=90%	DESIG=41
Γ_{19}	$\pi^0 \mu^+ \nu_\mu \gamma$	[a,b]	$(1.25 \pm 0.25) \times 10^{-5}$		DESIG=28
Γ_{20}	$\pi^0 \pi^0 e^+ \nu_e \gamma$	<	5×10^{-6}	CL=90%	DESIG=47
Hadronic modes with photons or $\ell\bar{\ell}$ pairs					
Γ_{21}	$\pi^+ \pi^0 \gamma (\text{INT})$		$(-4.2 \pm 0.9) \times 10^{-6}$		NODE=S010;CLUMP=D DESIG=119
Γ_{22}	$\pi^+ \pi^0 \gamma (\text{DE})$	[a,e]	$(6.0 \pm 0.4) \times 10^{-6}$		DESIG=38
Γ_{23}	$\pi^+ \pi^0 \pi^0 \gamma$	[a,b]	$(7.6 \pm 6.0) \times 10^{-6}$		DESIG=37
Γ_{24}	$\pi^+ \pi^+ \pi^- \gamma$	[a,b]	$(1.04 \pm 0.31) \times 10^{-4}$		DESIG=14
Γ_{25}	$\pi^+ \gamma \gamma$	[a]	$(1.10 \pm 0.32) \times 10^{-6}$		DESIG=17
Γ_{26}	$\pi^+ 3\gamma$	[a]	< 1.0 $\times 10^{-4}$	CL=90%	DESIG=23
Γ_{27}	$\pi^+ e^+ e^- \gamma$		$(1.19 \pm 0.13) \times 10^{-8}$		DESIG=118
Leptonic modes with $\ell\bar{\ell}$ pairs					
Γ_{28}	$e^+ \nu_e \nu \bar{\nu}$	<	6×10^{-5}	CL=90%	NODE=S010;CLUMP=E DESIG=33
Γ_{29}	$\mu^+ \nu_\mu \nu \bar{\nu}$	<	6.0×10^{-6}	CL=90%	DESIG=27
Γ_{30}	$e^+ \nu_e e^+ e^-$		$(2.48 \pm 0.20) \times 10^{-8}$		DESIG=32
Γ_{31}	$\mu^+ \nu_\mu e^+ e^-$		$(7.06 \pm 0.31) \times 10^{-8}$		DESIG=30
Γ_{32}	$e^+ \nu_e \mu^+ \mu^-$		$(1.7 \pm 0.5) \times 10^{-8}$		DESIG=48
Γ_{33}	$\mu^+ \nu_\mu \mu^+ \mu^-$	<	4.1×10^{-7}	CL=90%	DESIG=117
Lepton Family number (LF), Lepton number (L), $\Delta S = \Delta Q$ (SQ) violating modes, or $\Delta S = 1$ weak neutral current (S1) modes					
Γ_{34}	$\pi^+ \pi^+ e^- \bar{\nu}_e$	SQ	< 1.3 $\times 10^{-8}$	CL=90%	NODE=S010;CLUMP=F DESIG=8
Γ_{35}	$\pi^+ \pi^+ \mu^- \bar{\nu}_\mu$	SQ	< 3.0 $\times 10^{-6}$	CL=95%	DESIG=10
Γ_{36}	$\pi^+ e^+ e^-$	S1	$(3.00 \pm 0.09) \times 10^{-7}$		DESIG=15
Γ_{37}	$\pi^+ \mu^+ \mu^-$	S1	$(9.4 \pm 0.6) \times 10^{-8}$	S=2.6	DESIG=16
Γ_{38}	$\pi^+ \nu \bar{\nu}$	S1	$(1.7 \pm 1.1) \times 10^{-10}$		DESIG=20
Γ_{39}	$\pi^+ \pi^0 \nu \bar{\nu}$	S1	< 4.3 $\times 10^{-5}$	CL=90%	DESIG=50
Γ_{40}	$\mu^- \nu e^+ e^+$	LF	< 2.1 $\times 10^{-8}$	CL=90%	DESIG=31
Γ_{41}	$\mu^+ \nu_e$	LF	[f] < 4 $\times 10^{-3}$	CL=90%	DESIG=34
Γ_{42}	$\pi^+ \mu^+ e^-$	LF	< 1.3 $\times 10^{-11}$	CL=90%	DESIG=29
Γ_{43}	$\pi^+ \mu^- e^+$	LF	< 5.2 $\times 10^{-10}$	CL=90%	DESIG=25
Γ_{44}	$\pi^- \mu^+ e^+$	L	< 5.0 $\times 10^{-10}$	CL=90%	DESIG=45
Γ_{45}	$\pi^- e^+ e^+$	L	< 6.4 $\times 10^{-10}$	CL=90%	DESIG=19
Γ_{46}	$\pi^- \mu^+ \mu^+$	L	[f] < 1.1 $\times 10^{-9}$	CL=90%	DESIG=46
Γ_{47}	$\mu^+ \bar{\nu}_e$	L	[f] < 3.3 $\times 10^{-3}$	CL=90%	DESIG=35
Γ_{48}	$\pi^0 e^+ \bar{\nu}_e$	L	< 3 $\times 10^{-3}$	CL=90%	DESIG=36
Γ_{49}	$\pi^+ \gamma$	[g]	< 2.3 $\times 10^{-9}$	CL=90%	DESIG=22

- [a] See the Particle Listings below for the energy limits used in this measurement.
- [b] Most of this radiative mode, the low-momentum γ part, is also included in the parent mode listed without γ 's.
- [c] Structure-dependent part.
- [d] See the "Note on $\pi^\pm \rightarrow \ell^\pm \nu \gamma$ and $K^\pm \rightarrow \ell^\pm \nu \gamma$ Form Factors" in the π^\pm Particle Listings for definitions and details.
- [e] Direct-emission branching fraction.
- [f] Derived from an analysis of neutrino-oscillation experiments.
- [g] Violates angular-momentum conservation.

LINKAGE=KD+

LINKAGE=KX

LINKAGE=SH

LINKAGE=SWK

LINKAGE=SJ

LINKAGE=CL

LINKAGE=AM

CONSTRAINED FIT INFORMATION

An overall fit to the mean life, a decay rate, and 13 branching ratios uses 32 measurements and one constraint to determine 8 parameters. The overall fit has a $\chi^2 = 51.8$ for 25 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta p_i \delta p_j \rangle / (\delta p_i \delta p_j)$, in percent, from the fit to parameters p_i , including the branching fractions, $x_i \equiv \Gamma_i / \Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

x_3	-64						
x_4	-62	90					
x_5	-3	4	3				
x_9	-65	1	-1	0			
x_{10}	-13	-6	-6	0	-6		
x_{11}	-21	-9	-9	0	-10	3	
Γ	5	2	2	0	2	-1	-24
	x_2	x_3	x_4	x_5	x_9	x_{10}	x_{11}

Mode	Rate (10^8 s^{-1})	Scale factor	
$\Gamma_2 \mu^+ \nu_\mu$	0.5133 ± 0.0013	1.5	DESIG=1
$\Gamma_3 \pi^0 e^+ \nu_e$	0.0410 ± 0.0004	2.1	DESIG=6
Called K_{e3}^+ .			
$\Gamma_4 \pi^0 \mu^+ \nu_\mu$	0.02708 ± 0.00028	1.9	DESIG=5
Called $K_{\mu 3}^+$.			
$\Gamma_5 \pi^0 \pi^0 e^+ \nu_e$	$(1.77 \quad {}^{+0.35}_{-0.30}) \times 10^{-5}$		DESIG=24
$\Gamma_9 \pi^+ \pi^0$	0.1669 ± 0.0007	1.3	DESIG=2
$\Gamma_{10} \pi^+ \pi^0 \pi^0$	0.01423 ± 0.00018	1.1	DESIG=4
$\Gamma_{11} \pi^+ \pi^+ \pi^-$	0.04518 ± 0.00029	1.2	DESIG=3

NODE=S010235

 Γ_2 NODE=S010W1
NODE=S010W1**51.33±0.13 OUR FIT** Error includes scale factor of 1.5.

• • • We do not use the following data for averages, fits, limits, etc. • • •

51.2 ± 0.8 FORD 67 CNTR ±

 $\Gamma(\mu^+ \nu_\mu)$ **51.33±0.13 OUR FIT** Error includes scale factor of 1.5.

• • • We do not use the following data for averages, fits, limits, etc. • • •

51.2 ± 0.8 FORD 67 CNTR ±

 $\Gamma(\pi^+ \pi^+ \pi^-)$ **4.518±0.029 OUR FIT** Error includes scale factor of 1.2.**4.511±0.024** 7 FORD 70 ASPK

• • • We do not use the following data for averages, fits, limits, etc. • • •

4.529±0.032 3.2M 7 FORD 70 ASPK

4.496±0.030 7 FORD 67 CNTR ±

NODE=S010W2
NODE=S010W2

OCCUR=2

NODE=S010W2;LINKAGE=F

⁷ First FORD 70 value is second FORD 70 combined with FORD 67.

$(\Gamma(K^+) - \Gamma(K^-)) / \Gamma(K)$

NODE=S010240

 $K^\pm \rightarrow \mu^\pm \nu_\mu$ RATE DIFFERENCE/AVERAGETest of *CPT* conservation.

VALUE (%)	DOCUMENT ID	TECN
-0.54±0.41	FORD	67 CNTR

NODE=S010D1
NODE=S010D1
NODE=S010D1 $K^\pm \rightarrow \pi^\pm \pi^+ \pi^-$ RATE DIFFERENCE/AVERAGETest of *CP* conservation.

VALUE (%)	EVTS	DOCUMENT ID	TECN	CHG
0.08±0.12	8	FORD	70 ASPK	

NODE=S010D2
NODE=S010D2
NODE=S010D2
OCCUR=2

• • • We do not use the following data for averages, fits, limits, etc. • • •

-0.02±0.16	9	SMITH	73 ASPK	±
0.10±0.14	3.2M	8 FORD	70 ASPK	
-0.50±0.90		FLETCHER	67 OSPK	
-0.04±0.21	8	FORD	67 CNTR	

8 First FORD 70 value is second FORD 70 combined with FORD 67.

9 SMITH 73 value of $K^\pm \rightarrow \pi^\pm \pi^+ \pi^-$ rate difference is derived from SMITH 73 value of $K^\pm \rightarrow \pi^\pm 2\pi^0$ rate difference.NODE=S010D2;LINKAGE=F
NODE=S010D2;LINKAGE=S $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$ RATE DIFFERENCE/AVERAGETest of *CP* conservation.

VALUE (%)	EVTS	DOCUMENT ID	TECN	CHG
0.0 ±0.6 OUR AVERAGE				
0.08±0.58		SMITH	73 ASPK	±
-1.1 ±1.8	1802	HERZO	69 OSPK	

NODE=S010D3
NODE=S010D3
NODE=S010D3 $K^\pm \rightarrow \pi^\pm \pi^0$ RATE DIFFERENCE/AVERAGETest of *CPT* conservation.

VALUE (%)	DOCUMENT ID	TECN
0.8±1.2	HERZO	69 OSPK

NODE=S010D4
NODE=S010D4
NODE=S010D4 $K^\pm \rightarrow \pi^\pm \pi^0 \gamma$ RATE DIFFERENCE/AVERAGETest of *CP* conservation.

VALUE (%)	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
0.9±3.3 OUR AVERAGE					
0.8±5.8	2461	SMITH	76 WIRE	±	E_π 55–90 MeV
1.0±4.0	4000	ABRAMS	73B ASPK	±	E_π 51–100 MeV

NODE=S010D5
NODE=S010D5
NODE=S010D5 K^+ BRANCHING RATIOS

NODE=S010245

— Leptonic and semileptonic modes —

 $\Gamma(e^+ \nu_e) / \Gamma(\mu^+ \nu_\mu)$ Γ_1 / Γ_2

NODE=S010405

See the note on "Decay Constants of Charged Pseudoscalar Mesons" in the D_s^+ Listings.

VALUE (units 10^{-5})	EVTS	DOCUMENT ID	TECN	CHG
2.488±0.012 OUR AVERAGE				
2.487±0.011±0.007	60k	10 LAZZERONI	11 NA62	+
2.493±0.025±0.019	13.8K	11 AMBROSINO	09E KLOE	±
• • • We do not use the following data for averages, fits, limits, etc. • • •				
2.51 ±0.15	404	HEINTZ	76 SPEC	+
2.37 ±0.17	534	HEARD	75B SPEC	+
2.42 ±0.42	112	CLARK	72 OSPK	+

NODE=S010R28

NODE=S010R28

NODE=S010R28

10 This ratio is defined to be fully inclusive, including internal-bremsstrahlung.

NODE=S010R28;LINKAGE=LA

11 The ratio is defined to include internal-bremsstrahlung, ignoring direct-emission contributions. AMBROSINO 09E determined the ratio from the measurement of $\Gamma(K \rightarrow e\nu(\gamma))$, $E_\gamma < 10$ MeV / $\Gamma(K \rightarrow \mu\nu(\gamma))$. 89.8% of $K \rightarrow e\nu(\gamma)$ events had $E_\gamma < 10$ MeV.

NODE=S010R28;LINKAGE=AM

 $\Gamma(\mu^+ \nu_\mu) / \Gamma_{\text{total}}$ Γ_2 / Γ

NODE=S010R1

See the note on "Decay Constants of Charged Pseudoscalar Mesons" in the D_s^+ Listings.

NODE=S010R1

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
63.55±0.11 OUR FIT					Error includes scale factor of 1.2.
63.60±0.16 OUR AVERAGE					

NODE=S010R1

63.66±0.09±0.15	865k	12 AMBROSINO	06A KLOE	+
63.24±0.44	62k	CHIANG	72 OSPK	+

NODE=S010R1

12 Fully inclusive. Used tagged kaons from ϕ decays.

NODE=S010R1;LINKAGE=AM

$\Gamma(\pi^0 e^+ \nu_e)/\Gamma_{\text{total}}$						Γ_3/Γ
VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT	
5.07 ± 0.04 OUR FIT		Error includes scale factor of 2.1.				
4.94 ± 0.05 OUR AVERAGE						

4.965 ± 0.038 ± 0.037	13	AMBROSINO	08A	KLOE	±	
4.86 ± 0.10	3516	CHIANG	72	OSPK	+	1.84 GeV/c K^+
• • • We do not use the following data for averages, fits, limits, etc. • • •						
4.7 ± 0.3	429	SHAKLEE	64	HLBC	+	
5.0 ± 0.5		ROE	61	HLBC	+	

13 Depends on K^+ lifetime τ . AMBROSINO 08A uses PDG 06 value of $\tau = (1.2385 \pm 0.0024) \times 10^{-8}$ sec. The correlation between K_{e3}^+ and $K_{\mu 3}^+$ branching fraction measurements is 62.7%.

NODE=S010R6
NODE=S010R6

$\Gamma(\pi^0 e^+ \nu_e)/\Gamma(\mu^+ \nu_\mu)$						Γ_3/Γ_2
VALUE	EVTS	DOCUMENT ID	TECN	CHG		
0.0798 ± 0.0008 OUR FIT		Error includes scale factor of 1.9.				

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.069 ± 0.006	350	ZELLER	69	ASPK	+	
0.0775 ± 0.0033	960	BOTTERILL	68C	ASPK	+	
0.069 ± 0.006	561	GARLAND	68	OSPK	+	
0.0791 ± 0.0054	295	14 AUERBACH	67	OSPK	+	

14 AUERBACH 67 changed from 0.0797 ± 0.0054 . See comment with ratio $\Gamma(\pi^0 e^+ \nu_e)/\Gamma(\mu^+ \nu_\mu)$. The value 0.0785 ± 0.0025 given in AUERBACH 67 is an average of AUERBACH 67 $\Gamma(\pi^0 e^+ \nu_e)/\Gamma(\mu^+ \nu_\mu)$ and CESTER 66 $\Gamma(\pi^0 e^+ \nu_e)/[\Gamma(\mu^+ \nu_\mu) + \Gamma(\pi^+ \pi^0)]$.

NODE=S010R6;LINKAGE=AM

$\Gamma(\pi^0 e^+ \nu_e)/[\Gamma(\mu^+ \nu_\mu) + \Gamma(\pi^+ \pi^0)]$						$\Gamma_3/(\Gamma_2+\Gamma_9)$
VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG		
6.02 ± 0.06 OUR FIT		Error includes scale factor of 2.1.				
6.02 ± 0.15 OUR AVERAGE						

6.16 ± 0.22	5110	ESCHSTRUTH	68	OSPK	+	
5.89 ± 0.21	1679	CESTER	66	OSPK	+	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
5.92 ± 0.65	15 WEISSENBERG	76	SPEC	+		

15 Value calculated from WEISSENBERG 76 ($\pi^0 e\nu$), ($\mu\nu$), and ($\pi\pi^0$) values to eliminate dependence on our 1974 ($\pi 2\pi^0$) and ($\pi\pi^+\pi^-$) fractions.

NODE=S010R25;LINKAGE=A

$\Gamma(\pi^0 e^+ \nu_e)/[\Gamma(\pi^0 \mu^+ \nu_\mu) + \Gamma(\pi^+ \pi^0) + \Gamma(\pi^+ \pi^0 \pi^0)]$						$\Gamma_3/(\Gamma_4+\Gamma_9+\Gamma_{10})$
VALUE	EVTS	DOCUMENT ID	TECN	CHG		
0.1968 ± 0.0016 OUR FIT		Error includes scale factor of 2.4.				
0.1962 ± 0.0008 ± 0.0035	71k	SHER	03	B865	+	

$\Gamma(\pi^0 e^+ \nu_e)/(\Gamma(\pi^+ \pi^0))$						Γ_3/Γ_9
VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT	
0.2455 ± 0.0023 OUR FIT		Error includes scale factor of 2.6.				
0.2470 ± 0.0009 ± 0.0004	87k	BATLEY	07A	NA48	±	

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.221 ± 0.012	786	16 LUCAS	73B	HBC	—	Dalitz pairs only
---------------	-----	----------	-----	-----	---	-------------------

16 LUCAS 73B gives $N(K_{e3}) = 786 \pm 3.1\%$, $N(2\pi) = 3564 \pm 3.1\%$. We use these values to obtain quoted result.

NODE=S010R23;LINKAGE=W

$\Gamma(\pi^0 e^+ \nu_e)/(\Gamma(\pi^+ \pi^+ \pi^-))$						Γ_3/Γ_{11}
VALUE	EVTS	DOCUMENT ID	TECN	CHG		
0.907 ± 0.010 OUR FIT		Error includes scale factor of 1.6.				
• • • We do not use the following data for averages, fits, limits, etc. • • •						

0.867 ± 0.027	2768	BARMIN	87	XEBC	+	
0.856 ± 0.040	2827	BRAUN	75	HLBC	+	
0.850 ± 0.019	4385	17 HAIDT	71	HLBC	+	
0.846 ± 0.021	4385	17 EICHTEN	68	HLBC	+	
0.94 ± 0.09	854	BELLOTTI	67B	HLBC	+	
0.90 ± 0.06	230	BORREANI	64	HBC	+	

17 HAIDT 71 is a reanalysis of EICHTEN 68. Not included in average because of large discrepancy in $\Gamma(\pi^0 \mu^+ \nu)/\Gamma(\pi^0 e^+ \nu)$ with more precise results.

NODE=S010R43;LINKAGE=L

NODE=S010R43;LINKAGE=L

NODE=S010R20;LINKAGE=H

$\Gamma(\pi^0 \mu^+ \nu_\mu)/\Gamma_{\text{total}}$						Γ_4/Γ	
VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT		NODE=S010R5 NODE=S010R5
3.353±0.034 OUR FIT	Error includes scale factor of 1.8.						
3.24 ±0.04 OUR AVERAGE							
3.233±0.029±0.026	18	AMBROSINO	08A	KLOE	±		
3.33 ±0.16	2345	CHIANG	72	OSPK	+	1.84 GeV/c K^+	
• • • We do not use the following data for averages, fits, limits, etc. • • •							
2.8 ±0.4	19	TAYLOR	59	EMUL	+		
18	Depends on K^+ lifetime τ . AMBROSINO 08A uses PDG 06 value of $\tau = (1.2385 \pm 0.0024) \times 10^{-8}$ sec. The correlation between K_{e3}^+ and $K_{\mu 3}^+$ branching fraction measurements is 62.7%.						NODE=S010R5;LINKAGE=AM
19	Earlier experiments not averaged.						
$\Gamma(\pi^0 \mu^+ \nu_\mu)/\Gamma(\mu^+ \nu_\mu)$						Γ_4/Γ_2	
VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT		NODE=S010R5;LINKAGE=O
0.0528±0.0006 OUR FIT	Error includes scale factor of 1.8.						
• • • We do not use the following data for averages, fits, limits, etc. • • •							
0.054 ±0.009	240	ZELLER	69	ASPK	+		
0.0480±0.0037	424	20 GARLAND	68	OSPK	+		
0.0486±0.0040	307	21 AUERBACH	67	OSPK	+		
20	GARLAND 68 changed from 0.055 ± 0.004 in agreement with μ -spectrum calculation of GAILLARD 70 appendix B. L.G.Pondrom, (private communication 73).						NODE=S010R26;LINKAGE=G
21	AUERBACH 67 changed from 0.0602 ± 0.0046 by erratum which brings the μ -spectrum calculation into agreement with GAILLARD 70 appendix B.						NODE=S010R26;LINKAGE=A
$\Gamma(\pi^0 \mu^+ \nu_\mu)/\Gamma(\pi^0 e^+ \nu_e)$						Γ_4/Γ_3	
VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT		NODE=S010R29 NODE=S010R29
0.6608±0.0030 OUR FIT	Error includes scale factor of 1.1.						
0.6618±0.0027 OUR AVERAGE							
0.663 ±0.003 ±0.001	77k	BATLEY	07A	NA48	±		
0.671 ±0.007 ±0.008	24k	HORIE	01	SPEC			
0.670 ±0.014	22 HEINTZE	77	SPEC	+			
0.667 ±0.017	5601	BOTTERILL	68B	ASPK	+		
• • • We use the following data for averages but not for fits. • • •							
0.6511±0.0064	23	AMBROSINO	08A	KLOE	±		NOTFITTED
• • • We do not use the following data for averages, fits, limits, etc. • • •							
0.608 ±0.014	1585	24 BRAUN	75	HLBC	+		
0.705 ±0.063	554	25 LUCAS	73B	HBC	–	Dalitz pairs only	
0.698 ±0.025	3480	26 CHIANG	72	OSPK	+	1.84 GeV/c K^+	
0.596 ±0.025		27 HAIDT	71	HLBC	+		
0.604 ±0.022	1398	27 EICHEN	68	HLBC			
0.703 ±0.056	1509	CALLAHAN	66B	HLBC			
22 HEINTZE 77 value from fit to λ_0 . Assumes μ -e universality.							
23 Not used in the fit. This result enters the fit via correlation of K_{e3}^+ and $K_{\mu 3}^+$ branching fraction measurements of AMBROSINO 08A.							NODE=S010R29;LINKAGE=E
24 BRAUN 75 value is from form factor fit. Assumes μ -e universality.							NODE=S010R29;LINKAGE=AM
25 LUCAS 73B gives $N(K_{\mu 3}) = 554 \pm 7.6\%$, $N(K_{e3}) = 786 \pm 3.1\%$. We divide.							NODE=S010R29;LINKAGE=B
26 CHIANG 72 $\Gamma(\pi^0 \mu^+ \nu_\mu)/\Gamma(\pi^0 e^+ \nu_e)$ is statistically independent of CHIANG 72 $\Gamma(\pi^0 \mu^+ \nu_\mu)/\Gamma_{\text{total}}$ and $\Gamma(\pi^0 e^+ \nu_e)/\Gamma_{\text{total}}$.							NODE=S010R29;LINKAGE=L
27 HAIDT 71 is a reanalysis of EICHEN 68. Not included in average because of large discrepancy with more precise results.							NODE=S010R29;LINKAGE=D
							NODE=S010R29;LINKAGE=H
$[\Gamma(\pi^0 \mu^+ \nu_\mu) + \Gamma(\pi^+ \pi^0)]/\Gamma_{\text{total}}$						$(\Gamma_4 + \Gamma_9)/\Gamma$	
VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT		NODE=S010R7 NODE=S010R7
24.02±0.08 OUR FIT	Error includes scale factor of 1.2.						
• • • We do not use the following data for averages, fits, limits, etc. • • •							
25.4 ±0.9	886	SHAKLEE	64	HLBC	+		
23.4 ±1.1		ROE	61	HLBC	+		
$\Gamma(\pi^0 \mu^+ \nu_\mu)/\Gamma(\pi^+ \pi^0)$						Γ_4/Γ_9	
VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT		NODE=S010R76 NODE=S010R76
0.1637±0.0006±0.0003	77k	BATLEY	07A	NA48	±		

$\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma(\pi^+\pi^+\pi^-)$

VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
-------	------	-------------	------	-----	---------

0.599±0.007 OUR FIT Error includes scale factor of 1.6.

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.503±0.019	1505	28 HAITDT	71	HLBC	+
0.510±0.017	1505	28 EICHTEN	68	HLBC	+
0.63 ± 0.07	2845	29 BISI	65B	BC	+

28 HAITDT 71 is a reanalysis of EICHTEN 68. Not included in average because of large discrepancy in $\Gamma(\pi^0\mu^+\nu)/\Gamma(\pi^0e^+\nu)$ with more precise results.

29 Error enlarged for background problems. See GAILLARD 70.

 Γ_4/Γ_{11}

NODE=S010R19
NODE=S010R19

 $\Gamma(\pi^0\pi^0e^+\nu_e)/\Gamma_{\text{total}}$

VALUE (units 10^{-5})	EVTS	DOCUMENT ID	TECN	CHG
--------------------------	------	-------------	------	-----

2.2 ± 0.4 OUR FIT

2.54±0.89 10 BARMIN 88B HLBC +

 Γ_5/Γ

NODE=S010R66
NODE=S010R66

 $\Gamma(\pi^0\pi^0e^+\nu_e)/\Gamma(\pi^0e^+\nu_e)$

VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN	CHG
--------------------------	------	-------------	------	-----

4.3±0.9 **0.7 OUR FIT**

4.1±1.0 OUR AVERAGE

4.2 ^{+1.0} -0.9	25	BOLOTOV	86B	CALO	-
3.8 ^{+5.0} -1.2	2	LJUNG	73	HLBC	+

 Γ_5/Γ_3

NODE=S010R38
NODE=S010R38

 $\Gamma(\pi^+\pi^-e^+\nu_e)/\Gamma(\pi^+\pi^+\pi^-)$

VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN	CHG
--------------------------	------	-------------	------	-----

7.606±0.029 OUR AVERAGE

$[(7.31 \pm 0.16) \times 10^{-4}$ OUR 2012 AVERAGE]

7.615±0.008±0.028	1.1M	30 BATLEY	12	NA48	±
7.35 ± 0.01 ± 0.19	388k	31 PISLAK	01	B865	
7.21 ± 0.32	30k	ROSSELET	77	SPEC	+

• • • We do not use the following data for averages, fits, limits, etc. • • •

7.36 ± 0.68	500	BOURQUIN	71	ASPK	
7.0 ± 0.9	106	SCHWEINB...	71	HLBC	+
5.83 ± 0.63	269	ELY	69	HLBC	+

30 BATLEY 12 uses data collected in 2003–2004. The result is inclusive of $K^\pm \rightarrow \pi^\pm \pi^- e^\pm \nu \gamma$ decays. Using PDG 12 value for $\Gamma(\pi^+\pi^-\pi^+)/\Gamma = (5.59 \pm 0.04) \times 10^{-2}$. BATLEY 12 obtains $B(\pi^+\pi^-e\nu) = (4.257 \pm 0.004 \pm 0.035) \times 10^{-5}$ where the syst. error is dominated by the error on the normalization mode.

31 PISLAK 01 reports $\Gamma(\pi^+\pi^-e^+\nu_e)/\Gamma_{\text{total}} = (4.109 \pm 0.008 \pm 0.110) \times 10^{-5}$ using the PDG 00 value $\Gamma(\pi^+\pi^+\pi^-)/\Gamma_{\text{total}} = (5.59 \pm 0.05) \times 10^{-2}$. We divide by the PDG value and unfold its error from the systematic error. PISLAK 03 and PISLAK 10A give additional details on the branching ratio measurement and give improved errors on the S-wave $\pi\pi$ scattering length: $a_0^0 = 0.235 \pm 0.013$ and $a_0^2 = -0.0410 \pm 0.0027$.

 Γ_6/Γ_{11}

NODE=S010R21
NODE=S010R21
NEW

 $\Gamma(\pi^+\pi^-\mu^+\nu_\mu)/\Gamma_{\text{total}}$

VALUE (units 10^{-5})	EVTS	DOCUMENT ID	TECN	CHG
--------------------------	------	-------------	------	-----

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.77 ^{+0.54} -0.50	1	CLINE	65	FBC	+
--------------------------------	---	-------	----	-----	---

 Γ_7/Γ

NODE=S010R9
NODE=S010R9

 $\Gamma(\pi^+\pi^-\mu^+\nu_\mu)/\Gamma(\pi^+\pi^+\pi^-)$

VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN	CHG
--------------------------	------	-------------	------	-----

2.57±1.55 7 BISI 67 DBC +

• • • We do not use the following data for averages, fits, limits, etc. • • •

~2.5	1	GREINER	64	EMUL	+
------	---	---------	----	------	---

 Γ_7/Γ_{11}

NODE=S010R22
NODE=S010R22

 $\Gamma(\pi^0\pi^0\pi^0e^+\nu_e)/\Gamma_{\text{total}}$

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID	TECN	CHG
--------------------------	-----	------	-------------	------	-----

<3.5 90 0 BOLOTOV 88 SPEC -

• • • We do not use the following data for averages, fits, limits, etc. • • •

<9	90	0	BARMIN	92	XEBC	+
----	----	---	--------	----	------	---

 Γ_8/Γ

NODE=S010R68
NODE=S010R68

Hadronic modes

$\Gamma(\pi^+\pi^0)/\Gamma_{\text{total}}$						Γ_9/Γ	
VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT		NODE=S010410
20.66±0.08 OUR FIT	Error includes scale factor of 1.2.						NODE=S010R2 NODE=S010R2
20.70±0.16 OUR AVERAGE	Error includes scale factor of 1.8.						
20.65±0.05±0.08	1.4M	32 AMBROSINO	08E	KLOE	+	$\phi \rightarrow K^+K^-$	
21.18±0.28	16k	CHIANG	72	OSPK	+	1.84 GeV/c K^+	
• • • We do not use the following data for averages, fits, limits, etc. • • •							
21.0 ± 0.6		CALLAHAN	65	HLBC		See Γ_9/Γ_{11}	
32 Fully inclusive of final-state radiation. The branching ratio is evaluated using K^+ lifetime, $\tau = 12.385$ ns.							NODE=S010R2;LINKAGE=AM
$\Gamma(\pi^+\pi^0)/\Gamma(\pi^+\pi^+\pi^-)$						Γ_9/Γ_{11}	
VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT		NODE=S010R17 NODE=S010R17
3.694±0.029 OUR FIT	Error includes scale factor of 1.2.						
• • • We do not use the following data for averages, fits, limits, etc. • • •							
3.96 ± 0.15	1045	CALLAHAN	66	FBC	+		
$\Gamma(\pi^+\pi^0)/\Gamma(\mu^+\nu_\mu)$						Γ_9/Γ_2	
VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT		NODE=S010R24 NODE=S010R24
0.3252±0.0016 OUR FIT	Error includes scale factor of 1.2.						
0.3325±0.0032 OUR AVERAGE							
0.3329±0.0047±0.0010	45k	USHER	92	SPEC	+	$p\bar{p}$ at rest	
0.3355±0.0057	33	WEISSENBE...	76	SPEC	+		
0.3277±0.0065	4517	34 AUERBACH	67	OSPK	+		
• • • We do not use the following data for averages, fits, limits, etc. • • •							
0.328 ± 0.005	25k	33 WEISSENBE...	74	STRC	+		
0.305 ± 0.018	1600	ZELLER	69	ASPK	+		
33 WEISSENBERG 76 revises WEISSENBERG 74. 34 AUERBACH 67 changed from 0.3253 ± 0.0065 . See comment with ratio $\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma(\mu^+\nu_\mu)$.							NODE=S010R24;LINKAGE=W NODE=S010R24;LINKAGE=A
$\Gamma(\pi^+\pi^0\pi^0)/\Gamma_{\text{total}}$						Γ_{10}/Γ	
VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT		NODE=S010R4 NODE=S010R4
1.761±0.022 OUR FIT	Error includes scale factor of 1.1.						
1.775±0.028 OUR AVERAGE							
1.763±0.013±0.022		ALOISIO	04A	KLOE	±		
1.84 ± 0.06	1307	CHIANG	72	OSPK	+	1.84 GeV/c K^+	
• • • We do not use the following data for averages, fits, limits, etc. • • •							
1.53 ± 0.11	198	35 PANDOLAS	70	EMUL	+		
1.8 ± 0.2	108	SHAKLEE	64	HLBC	+		
1.7 ± 0.2		ROE	61	HLBC	+		
1.5 ± 0.2	36 TAYLOR		59	EMUL	+		
35 Includes events of TAYLOR 59. 36 Earlier experiments not averaged.							NODE=S010R4;LINKAGE=P NODE=S010R4;LINKAGE=O
$\Gamma(\pi^+\pi^0\pi^0)/\Gamma(\pi^+\pi^0)$						Γ_{10}/Γ_9	
VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT		NODE=S010R44 NODE=S010R44
0.0852±0.0011 OUR FIT	Error includes scale factor of 1.1.						
• • • We do not use the following data for averages, fits, limits, etc. • • •							
0.081 ± 0.005	574	37 LUCAS	73B	HBC	—	Dalitz pairs only	
37 LUCAS 73B gives $N(\pi^2\pi^0) = 574 \pm 5.9\%$, $N(2\pi) = 3564 \pm 3.1\%$. We quote $0.5N(\pi^2\pi^0)/N(2\pi)$ where 0.5 is because only Dalitz pair π^0 's were used.							NODE=S010R44;LINKAGE=L
$\Gamma(\pi^+\pi^0\pi^0)/\Gamma(\pi^+\pi^+\pi^-)$						Γ_{10}/Γ_{11}	
VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT		NODE=S010R18 NODE=S010R18
0.315±0.004 OUR FIT	Error includes scale factor of 1.1.						
0.303±0.009							
• • • We do not use the following data for averages, fits, limits, etc. • • •							
0.393±0.099	17	YOUNG	65	EMUL	+		

$\Gamma(\pi^+\pi^-\pi^-)/\Gamma_{\text{total}}$

<u>VALUE (units 10^{-2})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	Γ_{11}/Γ
5.59±0.04 OUR FIT		Error includes scale factor of 1.3.				NODE=S010R3 NODE=S010R3
• • • We do not use the following data for averages, fits, limits, etc. • • •						
5.56±0.20	2330	38 CHIANG	72 OSPK	+	1.84 GeV/c K^+	
5.34±0.21	693	39 PANDOULAS	70 EMUL	+		
5.71±0.15		DEMARCO	65 HBC			
6.0 ±0.4	44	YOUNG	65 EMUL	+		
5.54±0.12	2332	CALLAHAN	64 HLBC	+		
5.1 ±0.2	540	SHAKLEE	64 HLBC	+		
5.7 ±0.3		ROE	61 HLBC	+		

38 Value is not independent of CHIANG 72 $\Gamma(\mu^+\nu_\mu)/\Gamma_{\text{total}}$, $\Gamma(\pi^+\pi^0)/\Gamma_{\text{total}}$, $\Gamma(\pi^+\pi^0\pi^0)/\Gamma_{\text{total}}$, $\Gamma(\pi^0\mu^+\nu_\mu)/\Gamma_{\text{total}}$, and $\Gamma(\pi^0e^+\nu_e)/\Gamma_{\text{total}}$.

39 Includes events of TAYLOR 59.

Leptonic and semileptonic modes with photons

 $\Gamma(\mu^+\nu_\mu\gamma)/\Gamma_{\text{total}}$

<u>VALUE (units 10^{-3})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	Γ_{12}/Γ
6.2±0.8 OUR AVERAGE						NODE=S010R45 NODE=S010R45
6.6±1.5	40,41	DEMIDOV	90 XEBC		$P(\mu) < 231.5 \text{ MeV}/c$	
6.0±0.9		BARMIN	88 HLBC	+	$P(\mu) < 231.5 \text{ MeV}/c$	OCCUR=2
• • • We do not use the following data for averages, fits, limits, etc. • • •						
3.5±0.8	41,42	DEMIDOV	90 XEBC		$E(\gamma) > 20 \text{ MeV}$	OCCUR=2
3.2±0.5	57 43	BARMIN	88 HLBC	+	$E(\gamma) > 20 \text{ MeV}$	
5.4±0.3		AKIBA	85 SPEC		$P(\mu) < 231.5 \text{ MeV}/c$	

40 $P(\mu)$ cut given in DEMIDOV 90 paper, 235.1 MeV/c, is a misprint according to authors (private communication).

41 DEMIDOV 90 quotes only inner bremsstrahlung (IB) part.

42 Not independent of above DEMIDOV 90 value. Cuts differ.

43 Not independent of above BARMIN 88 value. Cuts differ.

44 Assumes μ -e universality and uses constraints from $K \rightarrow e\nu\gamma$.

 $\Gamma(\mu^+\nu_\mu\gamma(\text{SD}^+)/\Gamma_{\text{total}}$

Structure-dependent part with $+\gamma$ helicity (SD^+ term). See the "Note on $\pi^\pm \rightarrow \ell^\pm \nu \gamma$ and $K^\pm \rightarrow \ell^\pm \nu \gamma$ Form Factors" in the π^\pm section of the Particle Data Listings above.

<u>VALUE (units 10^{-5})</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
1.33±0.12±0.18	2588	45 ADLER	00B	B787

• • • We do not use the following data for averages, fits, limits, etc. • • •

<3.0	90	AKIBA	85	SPEC
------	----	-------	----	------

45 ADLER 00B obtains the branching ratio by extrapolating the measurement in the kinematic region $E_\mu > 137 \text{ MeV}$, $E_\gamma > 90 \text{ MeV}$ to the full SD^+ phase-space. Also reports $|F_V + F_A| = 0.165 \pm 0.007 \pm 0.011$ and $-0.04 < F_V - F_A < 0.24$ at 90% CL.

 $\Gamma(\mu^+\nu_\mu\gamma(\text{SD}^+\text{INT}))/\Gamma_{\text{total}}$

Interference term between internal Bremsstrahlung and SD^+ term. See the "Note on $\pi^\pm \rightarrow \ell^\pm \nu \gamma$ and $K^\pm \rightarrow \ell^\pm \nu \gamma$ Form Factors" in the π^\pm section of the Particle Data Listings above.

<u>VALUE (units 10^{-5})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
<2.7	90	AKIBA	85 SPEC

 $\Gamma(\mu^+\nu_\mu\gamma(\text{SD}^- + \text{SD}^-\text{INT}))/\Gamma_{\text{total}}$

Sum of structure-dependent part with $-\gamma$ helicity (SD^- term) and interference term between internal Bremsstrahlung and SD^- term. See the "Note on $\pi^\pm \rightarrow \ell^\pm \nu \gamma$ and $K^\pm \rightarrow \ell^\pm \nu \gamma$ Form Factors" in the π^\pm section of the Particle Data Listings above.

<u>VALUE (units 10^{-4})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
<2.6	90	46 AKIBA	85 SPEC

46 Assumes μ -e universality and uses constraints from $K \rightarrow e\nu\gamma$.

 Γ_{11}/Γ

NODE=S010R3

NODE=S010R3

NODE=S010R3;LINKAGE=C

NODE=S010R3;LINKAGE=P

NODE=S010415

NODE=S010R45

NODE=S010R45

OCCUR=2

OCCUR=2

NODE=S010R45;LINKAGE=C

NODE=S010R45;LINKAGE=D

NODE=S010R45;LINKAGE=E

NODE=S010R45;LINKAGE=B

NODE=S010R45;LINKAGE=A

NODE=S010R60

NODE=S010R60

NODE=S010R60

NODE=S010R60;LINKAGE=AD

NODE=S010R61

NODE=S010R61

NODE=S010R61

NODE=S010R62

NODE=S010R62

NODE=S010R62

NODE=S010R62;LINKAGE=A

$\Gamma(e^+\nu_e\gamma)/\Gamma(\mu^+\nu_\mu)$

VALUE (units 10^{-5})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT	Γ_{16}/Γ_2
1.483±0.066±0.013	1.4K	47	AMBROSINO 09E	KLOE	$\pm E_\gamma$ in 10–250 MeV, $p_e > 200$ MeV/c	

47 AMBROSINO 09E measured the differential width $dR_\gamma/dE_\gamma = (1/\Gamma(K \rightarrow \mu\nu)) (d\Gamma(K \rightarrow e\nu\gamma)/dE_\gamma)$. Result obtained by integrating the differential width over E_γ from 10 to 250 MeV.

 $\Gamma(\pi^0 e^+ \nu_e \gamma)/\Gamma(\pi^0 e^+ \nu_e)$

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT	Γ_{17}/Γ_3
--------------------------	------	-------------	------	-----	---------	------------------------

0.505±0.032 OUR AVERAGE Error includes scale factor of 1.3. See the ideogram below.

0.47 ± 0.02 ± 0.03	4476	48	AKIMENKO 07	ISTR	$E_\gamma > 10$ MeV, $0.6 < \cos(\theta_{e\gamma}) < 0.9$	
0.46 ± 0.08	82	49	BARMIN	91	XEBC	$E_\gamma > 10$ MeV, $0.6 < \cos(\theta_{e\gamma}) < 0.9$
0.56 ± 0.04	192	50	BOLOTOV	86B	CALO	$E_\gamma > 10$ MeV
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1.81 ± 0.03 ± 0.07	4476	48	AKIMENKO 07	ISTR	$E_\gamma > 10$ MeV, $\theta_{e\gamma} > 10^\circ$	OCCUR=2
0.63 ± 0.02 ± 0.03	4476	48	AKIMENKO 07	ISTR	$E_\gamma > 30$ MeV, $\theta_{e\gamma} > 20^\circ$	OCCUR=3
1.51 ± 0.25	82	49	BARMIN	91	XEBC	$E_\gamma > 10$ MeV, $\cos(\theta_{e\gamma}) < 0.98$
0.48 ± 0.20	16	51	LJUNG	73	HLBC	$E_\gamma > 30$ MeV
0.22 ± 0.15 -0.10		51	LJUNG	73	HLBC	$E_\gamma > 30$ MeV
0.76 ± 0.28	13	52	ROMANO	71	HLBC	$E_\gamma > 10$ MeV
0.53 ± 0.22		52	ROMANO	71	HLBC	$E_\gamma > 30$ MeV
1.2 ± 0.8			BELLOTTI	67	HLBC	$E_\gamma > 30$ MeV

48 AKIMENKO 07 provides values for three kinematic regions. For averaging, we use value with $E_\gamma > 10$ MeV and $0.6 < \cos(\theta_{e\gamma}) < 0.9$.

49 BARMIN 91 quotes branching ratio $\Gamma(K \rightarrow e\pi^0\nu\gamma)/\Gamma_{\text{all}}$. The measured normalization is $[\Gamma(K \rightarrow e\pi^0\nu) + \Gamma(K \rightarrow \pi^+\pi^+\pi^-)]$. For comparison with other experiments we used $\Gamma(K \rightarrow e\pi^0\nu)/\Gamma_{\text{all}} = 0.0482$ to calculate the values quoted here.

50 $\cos(\theta_{e\gamma})$ between 0.6 and 0.9.

51 First LJUNG 73 value is for $\cos(\theta_{e\gamma}) < 0.9$, second value is for $\cos(\theta_{e\gamma})$ between 0.6 and 0.9 for comparison with ROMANO 71.

52 Both ROMANO 71 values are for $\cos(\theta_{e\gamma})$ between 0.6 and 0.9. Second value is for comparison with second LJUNG 73 value. We use lowest E_γ cut for Summary Table value. See ROMANO 71 for E_γ dependence.

NODE=S010R78
NODE=S010R78

NODE=S010R78;LINKAGE=AM

NODE=S010R30
NODE=S010R30

OCCUR=2

OCCUR=2
OCCUR=3

OCCUR=2

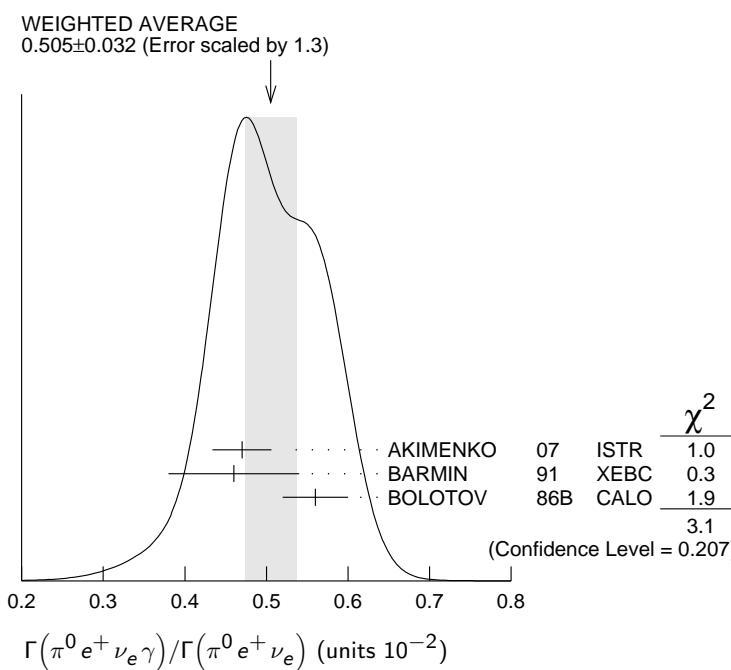
OCCUR=2

NODE=S010R30;LINKAGE=AK

NODE=S010R30;LINKAGE=A

NODE=S010R30;LINKAGE=C
NODE=S010R30;LINKAGE=L

NODE=S010R30;LINKAGE=R



$\Gamma(\pi^0 e^+ \nu_e \gamma(\text{SD}))/\Gamma_{\text{total}}$

Structure-dependent part.

VALUE (units 10^{-5})	CL%	DOCUMENT ID	TECN	CHG
<5.3	90	BOLOTOV	86B	CALO

 Γ_{18}/Γ

NODE=S010R64

NODE=S010R64

NODE=S010R64

 $\Gamma(\pi^0 \mu^+ \nu_\mu \gamma)/\Gamma_{\text{total}}$ Γ_{19}/Γ

VALUE (units 10^{-5})	CL%	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
1.25±0.25 OUR AVERAGE						

1.10±0.32±0.05 23 53 ADLER 10 B787 $30 < E_\gamma < 60$ MeV1.46±0.22±0.32 153 54 TCHIKILEV 07 ISTR – $30 < E_\gamma < 60$ MeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.4 ±0.5 ±0.6 125 SHIMIZU 06 K470 + $E_\gamma > 30$ MeV;
 $\Theta_{\mu\gamma} > 20^\circ$ <6.1 90 0 LJUNG 73 HLBC + $E(\gamma) > 30$ MeV53 Value obtained from $B(K^+ \rightarrow \pi^0 \mu^+ \nu_\mu \gamma) = (2.51 \pm 0.74 \pm 0.12) \times 10^{-5}$ obtained in the kinematic region $E_\gamma > 20$ MeV, and then theoretical $K_{\mu 3\gamma}$ spectrum has been used. Also $B(K^+ \rightarrow \pi^0 \mu^+ \nu_\mu \gamma) = (1.58 \pm 0.46 \pm 0.08) \times 10^{-5}$, for $E_\gamma > 30$ MeV and $\theta_{\mu\gamma} > 20^\circ$, was determined.54 Obtained from measuring $B(K_{\mu 3\gamma}) / B(K_{\mu 3})$ and using PDG 02 value $B(K_{\mu 3}) = 3.27\%$. $B(K_{\mu 3\gamma}) = (8.82 \pm 0.94 \pm 0.86) \times 10^{-5}$ is obtained for $5 \text{ MeV} < E_\gamma < 30$ MeV. $\Gamma(\pi^0 \pi^0 e^+ \nu_e \gamma)/\Gamma_{\text{total}}$ Γ_{20}/Γ

VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
<5	90	0	BARMIN	92	XEB	+ $E_\gamma > 10$ MeV

Hadronic modes with photons $\Gamma(\pi^+ \pi^0 \gamma(\text{INT}))/\Gamma_{\text{total}}$ Γ_{21}/Γ

The $K^+ \rightarrow \pi^+ \pi^0 \gamma$ differential decay rate can be described in terms of T_{π^+} , the charged pion kinetic energy, and $W^2 = (P_K \cdot P_\gamma) (P_{\pi^+} \cdot P_\gamma) / (m_K m_{\pi^+})^2$; then we can write $d^2\Gamma(K^+ \rightarrow \pi^+ \pi^0 \gamma) / (dT_{\pi^+} dW^2) = d^2\Gamma(K^+ \rightarrow \pi^+ \pi^0 \gamma)_{IB} / (dT_{\pi^+} dW^2) [1 + 2 \cos(\pm\phi + \delta_1^1 - \delta_0^2) m_\pi^2 m_K^2 W^2 X_E + m_\pi^4 m_K^4 (X_E^2 + X_M^2) W^4]$. The IB differential and total branching ratios are expressed in terms of the non-radiative experimental width $\Gamma(K^+ \rightarrow \pi^+ \pi^0)$ by Low's theorem. Using PDG 10 $B(K^+ \rightarrow \pi^+ \pi^0) = 0.2066 \pm 0.0008$, one obtains respectively $B(K^+ \rightarrow \pi^+ \pi^0 \gamma)_{IB} (55 < T_{\pi^+} < 90 \text{ MeV}) = 2.55 \times 10^{-4}$ and $B(K^+ \rightarrow \pi^+ \pi^0 \gamma)_{IB} (0 < T_{\pi^+} < 80 \text{ MeV}) = 1.80 \times 10^{-4}$. Fitting respectively the piece proportional to W^2 and the piece proportional to W^4 , the interference contribution (INT), proportional to X_E , and the direct contribution (DE) proportional to $X_E^2 + X_M^2$ are extracted.

VALUE (units 10^{-6})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
-4.24±0.63±0.70	600k	55 BATLEY	10A	NA48	± $T_{\pi^+} 0\text{--}80$ MeV

NODE=S010R71

NODE=S010R71

55 The cut on the photon energy implies $W^2 > 0.2$. BATLEY 10A obtains the INT and DE fractional branchings with respect to IB from a simultaneous kinematical fit of INT and DE and then we use the PDG 10 value for $B(K^+ \rightarrow \pi^+ \pi^0) = 20.66 \pm 0.08$ to determine the IB. The INT and DE correlation coefficients –0.83. Assuming a constant electric amplitude, X_E , this INT value implies $X_E = -24 \pm 6$ GeV $^{-4}$. $\Gamma(\pi^+ \pi^0 \gamma(\text{DE}))/\Gamma_{\text{total}}$ Γ_{22}/Γ Direct emission (DE) part of $\Gamma(\pi^+ \pi^0 \gamma)/\Gamma_{\text{total}}$, assuming that interference (INT) component is zero.

VALUE (units 10^{-6})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
5.99±0.27±0.25	600k	56 BATLEY	10A	NA48	± $T_{\pi^+} 0\text{--}80$ MeV

• • • We do not use the following data for averages, fits, limits, etc. • • •

3.8 ±0.8 ±0.7 10k ALIEV 06 K470 + $T_{\pi^+} 55\text{--}90$ MeV3.7 ±3.9 ±1.0 930 UVAROV 06 ISTR – $T_{\pi^-} 55\text{--}90$ MeV3.2 ±1.3 ±1.0 4k ALIEV 03 K470 + $T_{\pi^+} 55\text{--}90$ MeV6.1 ±2.5 ±1.9 4k ALIEV 03 K470 + T_{π^+} full range4.7 ±0.8 ±0.3 20k 57 ADLER 00C B787 + $T_{\pi^+} 55\text{--}90$ MeV20.5 ±4.6 +3.9 -2.3 BOLOTOV 87 WIRE – $T_{\pi^-} 55\text{--}90$ MeV15.6 ±3.5 ±5.0 ABRAMS 72 ASPK ± $T_{\pi^\pm} 55\text{--}90$ MeV

NODE=S010R65

NODE=S010R65

NODE=S010R65

OCCUR=2

56 The cut on the photon energy implies $W^2 > 0.2$. BATLEY 10A obtains the INT and DE fractional branchings with respect to IB from a simultaneous kinematical fit of INT and DE and then we use the PDG 10 value for $B(K^+ \rightarrow \pi^+ \pi^0) = 20.66 \pm 0.08$ to determine the IB. The INT and DE correlation coefficients -0.93 . Assuming constant electric and magnetic amplitudes, X_E and X_M , these INTand DE values imply $X_E = -24 \pm 6 \text{ GeV}^{-4}$ and $X_M = -254 \pm 9 \text{ GeV}^{-4}$.

57 ADLER 00C measures the INT component to be $(-0.4 \pm 1.6)\%$ of the inner bremsstrahlung (IB) component.

$\Gamma(\pi^+ \pi^0 \pi^0 \gamma)/\Gamma(\pi^+ \pi^0 \pi^0)$	Γ_{23}/Γ_{10}			
VALUE (units 10^{-4})	DOCUMENT ID	TECN	CHG	COMMENT
4.3^{+3.2}_{-1.7}	BOLOTOV	85	SPEC	—
				$E(\gamma) > 10 \text{ MeV}$

$\Gamma(\pi^+ \pi^+ \pi^- \gamma)/\Gamma_{\text{total}}$	Γ_{24}/Γ				
VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
1.04^{+0.31}_{-0.31} OUR AVERAGE					
1.10 \pm 0.48	7	BARMIN	89	XEBC	$E(\gamma) > 5 \text{ MeV}$
1.0 \pm 0.4		STAMER	65	EMUL	$E(\gamma) > 11 \text{ MeV}$

$\Gamma(\pi^+ \gamma \gamma)/\Gamma_{\text{total}}$	Γ_{25}/Γ					
VALUE (units 10^{-7})	CL%	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
11⁺³₋₁	31	58	KITCHING	97	B787	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 0.083	90	59	ARTAMONOV	05	B949	+
< 10	90	0	ATIYA	90B	B787	$T\pi > 117-127 \text{ MeV}$
< 84	90	0	ASANO	82	CNTR	+
-420 ± 520	0	ABRAMS	77	SPEC	+	$T\pi < 92 \text{ MeV}$
< 350	90	0	LJUNG	73	HLBC	+
< 500	90	0	KLEMS	71	OSPK	+
-100 ± 600		CHEN	68	OSPK	+	$T\pi < 117 \text{ MeV}$
						$T\pi > 60-90 \text{ MeV}$

58 KITCHING 97 is extrapolated from their model-independent branching fraction $(6.0 \pm 1.5 \pm 0.7) \times 10^{-7}$ for $100 \text{ MeV}/c < P_{\pi^+} < 180 \text{ MeV}/c$ using Chiral Perturbation Theory.

59 ARTAMONOV 05 limit assumes ChPT with $\hat{c}=1.8$ with unitarity corrections. With $\hat{c}=1.6$ and no unitarity corrections they obtain $< 2.3 \times 10^{-8}$ at 90% CL. This partial branching ratio is predicted to be 6.10×10^{-9} and 0.49×10^{-9} for the cases with and without unitarity correction.

$\Gamma(\pi^+ 3\gamma)/\Gamma_{\text{total}}$	Γ_{26}/Γ			
Values given here assume a phase space pion energy spectrum.	DOCUMENT ID	TECN	CHG	COMMENT
<1.0	90	ASANO	82	CNTR
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<3.0	90	KLEMS	71	OSPK
				$T(\pi) > 117 \text{ MeV}$

$\Gamma(\pi^+ e^+ e^- \gamma)/\Gamma_{\text{total}}$

VALUE (units 10^{-8})	EVTS	DOCUMENT ID	TECN	COMMENT
1.19^{+0.12}_{-0.04}	113	60	BATLEY	08

60 BATLEY 08 also reports the Chiral Perturbation Theory parameter $\hat{c} = 0.9 \pm 0.45$ obtained using the shape of the $e^+ e^- \gamma$ invariant mass spectrum. By extrapolating the theoretical amplitude to $m_{ee\gamma} < 260 \text{ MeV}$, it obtains the inclusive $B(K^+ \rightarrow \pi^+ e^+ e^- \gamma) = (1.29 \pm 0.13 \pm 0.03) \times 10^{-8}$, where the first error is the combined statistical and systematic errors and the second error is from the uncertainty in \hat{c} .

Leptonic modes with $\ell\bar{\ell}$ pairs

$\Gamma(e^+ \nu_e \nu \bar{\nu})/\Gamma(e^+ \nu_e)$	Γ_{28}/Γ_1					
VALUE	CL%	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
<3.8	90	0	HEINTZE	79	SPEC	+

$\Gamma(\mu^+ \nu_\mu \nu \bar{\nu})/\Gamma_{\text{total}}$	Γ_{29}/Γ					
VALUE (units 10^{-6})	CL%	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
<6.0	90	0	61	PANG	73	CNTR

61 PANG 73 assumes μ spectrum from ν - ν interaction of BARDIN 70.

NODE=S010R65;LINKAGE=BA

NODE=S010R65;LINKAGE=AD

NODE=S010R63
NODE=S010R63

NODE=S010R14
NODE=S010R14

NODE=S010R12
NODE=S010R12

NODE=S010R12;LINKAGE=A

NODE=S010R12;LINKAGE=AR

NODE=S010R36
NODE=S010R36
NODE=S010R36

NODE=S010R77
NODE=S010R77

NODE=S010R77;LINKAGE=BA

NODE=S010425

NODE=S010R56
NODE=S010R56

NODE=S010R41
NODE=S010R41

NODE=S010R41;LINKAGE=P

$\Gamma(e^+ \nu_e e^+ e^-)/\Gamma_{\text{total}}$						Γ_{30}/Γ
<u>VALUE (units 10^{-8})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
2.48 ± 0.14 ± 0.14	410	POBLAGUEV	02	B865 +	$m_{ee} > 150$ MeV	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
20 ± 20	4	DIAMANT...	76	SPEC +	$m_{e^+ e^-} > 140$ MeV	OCCUR=2

$\Gamma(\mu^+ \nu_\mu e^+ e^-)/\Gamma_{\text{total}}$						Γ_{31}/Γ
<u>VALUE (units 10^{-8})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
7.06 ± 0.16 ± 0.26	2.7k	POBLAGUEV	02	B865 +	$m_{ee} > 145$ MeV	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
100 ± 30	14	DIAMANT...	76	SPEC +	$m_{e^+ e^-} > 140$ MeV	

$\Gamma(e^+ \nu_e \mu^+ \mu^-)/\Gamma_{\text{total}}$						Γ_{32}/Γ
<u>VALUE (units 10^{-8})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
1.72 ± 0.45		MA	06	B865		
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<50	90	ADLER	98	B787		

$\Gamma(\mu^+ \nu_\mu \mu^+ \mu^-)/\Gamma_{\text{total}}$						Γ_{33}/Γ
<u>VALUE (units 10^{-7})</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
<4.1	90	ATIYA	89	B787 +		

— Lepton Family number (*LF*), Lepton number (*L*), $\Delta S = \Delta Q$ (*SQ*) —
— violating modes, or $\Delta S = 1$ weak neutral current (*S1*) modes —

$\Gamma(\pi^+ \pi^+ e^- \bar{\nu}_e)/\Gamma_{\text{total}}$						Γ_{34}/Γ
Test of $\Delta S = \Delta Q$ rule.						
<u>VALUE (units 10^{-7})</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 9.0	95	0	SCHWEINB...	71	HLBC +	
< 6.9	95	0	ELY	69	HLBC +	
<20.	95		BIRGE	65	FBC +	

$\Gamma(\pi^+ \pi^+ e^- \bar{\nu}_e)/\Gamma(\pi^+ \pi^- e^+ \nu_e)$						Γ_{34}/Γ_6
Test of $\Delta S = \Delta Q$ rule.						
<u>VALUE (units 10^{-4})</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	
< 3	90	3	62 BLOCH	76	SPEC	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<130.	95	0	BOURQUIN	71	ASPK	

62 BLOCH 76 quotes 3.6×10^{-4} at CL = 95%, we convert.

$\Gamma(\pi^+ \pi^+ \mu^- \bar{\nu}_\mu)/\Gamma_{\text{total}}$						Γ_{35}/Γ
Test of $\Delta S = \Delta Q$ rule.						
<u>VALUE (units 10^{-6})</u>	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	
<3.0	95	0	BIRGE	65	FBC +	

$\Gamma(\pi^+ e^+ e^-)/\Gamma_{\text{total}}$						Γ_{36}/Γ
Test for $\Delta S = 1$ weak neutral current. Allowed by combined first-order weak and electromagnetic interactions.						
<u>VALUE (units 10^{-7})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>	<u>COMMENT</u>	
3.00 ± 0.09 OUR AVERAGE						
3.11 ± 0.04 ± 0.12 7253 63 BATLEY 09 NA48 ±						
2.94 ± 0.05 ± 0.14 10300 64 APPEL 99 SPEC +						
2.75 ± 0.23 ± 0.13 500 65 ALLIEGRO 92 SPEC +						
2.7 ± 0.5 41 66 BLOCH 75 SPEC +						
63 Value extrapolated from a measurement in the region $z = (m_{ee}/m_K)^2 > 0.08$. BATLEY 09 also evaluated the shape of the form factor using four different theoretical models.						
64 APPEL 99 establishes vector nature of this decay and determines form factor $f(Z) = f_0(1+\delta Z)$, $Z=M_{ee}^2/m_K^2$, $\delta=2.14 \pm 0.13 \pm 0.15$.						
65 ALLIEGRO 92 assumes a vector interaction with a form factor given by $\lambda = 0.105 \pm 0.035 \pm 0.015$ and a correlation coefficient of -0.82 .						
66 BLOCH 75 assumes a vector interaction.						

NODE=S010R53
NODE=S010R53

NODE=S010R50
NODE=S010R50
NODE=S010R72
NODE=S010R72

NODE=S010430
NODE=S010R8
NODE=S010R8
NODE=S010R8

NODE=S010R37
NODE=S010R37
NODE=S010R37

NODE=S010R15
NODE=S010R15

NODE=S010R15

NODE=S010R15;LINKAGE=BA
NODE=S010R15;LINKAGE=AP
NODE=S010R15;LINKAGE=A
NODE=S010R15;LINKAGE=B

$\Gamma(\pi^+\mu^+\mu^-)/\Gamma_{\text{total}}$

Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interactions.

VALUE (units 10^{-8})	CL%	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
9.4 ± 0.6 OUR AVERAGE						Error includes scale factor of 2.6. See the ideogram below.

9.62 ± 0.21 ± 0.13	3120	67 BATLEY	11A NA48	±	2003-04 data
9.8 ± 1.0 ± 0.5	110	68 PARK	02 HYCP	±	
9.22 ± 0.60 ± 0.49	402	69 MA	00 B865	+	
5.0 ± 0.4 ± 0.9	207	70 ADLER	97C B787	+	

• • • We do not use the following data for averages, fits, limits, etc. • • •

9.7 ± 1.2 ± 0.4	65	PARK	02 HYCP	+	
10.0 ± 1.9 ± 0.7	35	PARK	02 HYCP	-	
<23	90	ATIYA	89 B787	+	

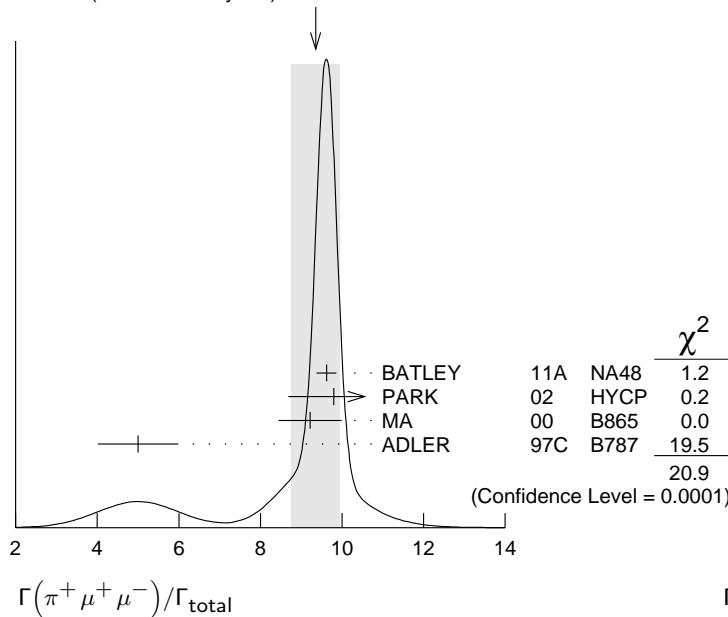
67 BATLEY 11A also studies the form factor $f(z)$ dependence of the decay, described via single photon exchange: i) assuming a linear form factor, $f(z) = f_0(1 + \delta z)$, $z = (M_{\mu\mu}/m_K)^2$, finding $f_0 = 0.470 \pm 0.040$ and $\delta = 3.11 \pm 0.57$ and ii) assuming a linear form factor including $\pi\pi$ rescattering, $W_{\pi\pi}$, as in DAMBROSIO 98A, finding $f(z) = G_F m_K^2 (a_+ + b_+ z) + W_{\pi\pi}(z)$, $a_+ = -0.575 \pm 0.039$, $b_+ = -0.813 \pm 0.145$.

68 PARK 02 “±” result comes from combining $K^+ \rightarrow \pi^+ \mu^+ \mu^-$ and $K^- \rightarrow \pi^- \mu^+ \mu^-$, assuming CP is conserved.

69 MA 00 establishes vector nature of this decay and determines form factor $f(z) = f_0(1 + \delta z)$, $z = (M_{\mu\mu}/m_K)^2$, $\delta = 2.45^{+1.30}_{-0.95}$.

70 ADLER 97C gives systematic error 0.7×10^{-8} and theoretical uncertainty 0.6×10^{-8} , which we combine in quadrature to obtain our second error.

WEIGHTED AVERAGE
9.4±0.6 (Error scaled by 2.6)

 $\Gamma(\pi^+\nu\bar{\nu})/\Gamma_{\text{total}}$

Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interactions. Branching ratio values are extrapolated from the momentum or energy regions shown in the comments assuming Standard Model phase space except for those labeled “Scalar” or “Tensor” to indicate the assumed non-Standard-Model interaction.

VALUE (units 10^{-9})	CL%	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
0.173^{+0.115}_{-0.105}	7	71 ARTAMONOV	08 B949	+	140 < P_π < 199 MeV, 211 < P_π < 229 MeV	

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.789 ^{+0.926} _{-0.510}	3	72 ARTAMONOV	08 B949	+	140 < P_π < 199 MeV	
< 2.2	90	1	73 ADLER	04 B787	+	211 < P_π < 229 MeV
< 2.7	90		ADLER	04 B787	+	Scalar

 Γ_{37}/Γ

NODE=S010R16

NODE=S010R16

NODE=S010R16

OCCUR=2

OCCUR=2

OCCUR=3

NODE=S010R16;LINKAGE=BA

NODE=S010R16;LINKAGE=PK

NODE=S010R16;LINKAGE=AP

NODE=S010R16;LINKAGE=A

 Γ_{38}/Γ

NODE=S010R32

NODE=S010R32

NODE=S010R32

OCCUR=2

OCCUR=2

< 1.8	90	ADLER	04	B787	+	Tensor	OCCUR=3
0.147 ^{+0.130} -0.089	3	74 ANISIMOVSKY	04	B949	+	$211 < P_\pi < 229$ MeV	
0.157 ^{+0.175} -0.082	2	ADLER	02	B787	+	$P_\pi > 211$ MeV/c	
< 4.2	90	1 ADLER	02C	B787	+	$140 < P_\pi < 195$ MeV	OCCUR=2
< 4.7	90	75 ADLER	02C	B787	+	Scalar	OCCUR=3
< 2.5	90	75 ADLER	02C	B787	+	Tensor	
0.15 ^{+0.34} -0.12	1	ADLER	00	B787		In ADLER 02	
0.42 ^{+0.97} -0.35	1	ADLER	97	B787			
< 2.4	90	ADLER	96	B787			
< 7.5	90	ATIYA	93	B787	+	$T(\pi)$ 115–127 MeV	
< 5.2	90	76 ATIYA	93	B787	+		OCCUR=2
< 17	90	0 ATIYA	93B	B787	+	$T(\pi)$ 60–100 MeV	
< 34	90	ATIYA	90	B787	+		
<140	90	ASANO	81B	CNTR	+	$T(\pi)$ 116–127 MeV	

71 Value obtained combining ANISIMOVSKY 04, ADLER 04, and the present ARTAMONOV 08 results.

72 Observed 3 events with an estimated background of $0.93 \pm 0.17^{+0.32}_{-0.24}$. Signal-to-background ratio for each of these 3 events is 0.20, 0.42, and 0.47.

73 Value obtained combining the previous result ADLER 02C with 1 event and the present result with 0 events to obtain an expected background 1.22 ± 0.24 events and 1 event observed.

74 Value obtained combining the previous E787 result ADLER 02 with 2 events and the present E949 with 1 event. The additional event has a signal-to-background ratio 0.9. Superseded by ARTAMONOV 08.

75 Superseded by ADLER 04.

76 Combining ATIYA 93 and ATIYA 93B results. Superseded by ADLER 96.

$\Gamma(\pi^+\pi^0\nu\bar{\nu})/\Gamma_{\text{total}}$

Γ_{39}/Γ

Test for $\Delta S = 1$ weak neutral current. Allowed by higher-order electroweak interactions.

VALUE (units 10^{-5})	CL%	DOCUMENT ID	TECN
<4.3	90	77 ADLER	01 SPEC

77 Search region defined by $90 \text{ MeV}/c < P_{\pi^+} < 188 \text{ MeV}/c$ and $135 \text{ MeV} < E_{\pi^0} < 180 \text{ MeV}$.

$\Gamma(\mu^-\nu e^+e^+)/\Gamma(\pi^+\pi^-e^+\nu_e)$

Γ_{40}/Γ_6

Test of lepton family number conservation.

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID	TECN	CHG
<0.5	90	0	78 DIAMANT-...	76 SPEC	+

78 DIAMANT-BERGER 76 quotes this result times our 1975 $\pi^+\pi^-e\nu$ BR ratio.

$\Gamma(\mu^+\nu_e)/\Gamma_{\text{total}}$

Γ_{41}/Γ

Forbidden by lepton family number conservation.

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
<0.004	90	0	79 LYONS	81 HLBC	200 GeV K^+ narrow band ν beam

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.012 90 79 COOPER 82 HLBC Wideband ν beam

79 COOPER 82 and LYONS 81 limits on ν_e observation are here interpreted as limits on lepton family number violation in the absence of mixing.

$\Gamma(\pi^+\mu^+e^-)/\Gamma_{\text{total}}$

Γ_{42}/Γ

Test of lepton family number conservation.

VALUE (units 10^{-10})	CL%	DOCUMENT ID	TECN	CHG
<0.13	90	80 SHER	05 RVUE	+

• • • We do not use the following data for averages, fits, limits, etc. • • •

<0.21 90 SHER 05 B865 +

<0.39 90 APPEL 00 B865 +

<2.1 90 LEE 90 SPEC +

80 This result combines SHER 05 1998 data, APPEL 00 1996 data, and data from BERGMAN 97 and PISLAK 97 theses, all from BNL-E865, with LEE 90 BNL-E777 data.

OCCUR=3

OCCUR=2

OCCUR=3

NODE=S010R32;LINKAGE=AR

NODE=S010R32;LINKAGE=AT

NODE=S010R32;LINKAGE=AD

NODE=S010R32;LINKAGE=AN

NODE=S010R32;LINKAGE=AL

NODE=S010R32;LINKAGE=A3

NODE=S010R74

NODE=S010R74

NODE=S010R74

NODE=S010R74;LINKAGE=A

NODE=S010R52

NODE=S010R52

NODE=S010R52

NODE=S010R52;LINKAGE=D

NODE=S010R57

NODE=S010R57

NODE=S010R57

NODE=S010R57;LINKAGE=L

NODE=S010R49

NODE=S010R49

NODE=S010R49

OCCUR=2

OCCUR=2

NODE=S010R49;LINKAGE=SH

$\Gamma(\pi^+ \mu^- e^+)/\Gamma_{\text{total}}$

Test of lepton family number conservation.

VALUE (units 10^{-10})	CL%	EVTS	DOCUMENT ID	TECN	CHG
< 5.2	90	0	APPEL	00B	B865 +

• • • We do not use the following data for averages, fits, limits, etc. • • •

<70	90	0	81 DIAMANT-...	76	SPEC +
-----	----	---	----------------	----	--------

81 Measurement actually applies to the sum of the $\pi^+ \mu^- e^+$ and $\pi^- \mu^+ e^+$ modes. Γ_{43}/Γ

NODE=S010R39

NODE=S010R39

NODE=S010R39

 $\Gamma(\pi^- \mu^+ e^+)/\Gamma_{\text{total}}$ Γ_{44}/Γ

Test of total lepton number conservation.

VALUE (units 10^{-10})	CL%	EVTS	DOCUMENT ID	TECN	CHG
< 5.0	90	0	APPEL	00B	B865 +

• • • We do not use the following data for averages, fits, limits, etc. • • •

<70	90	0	82 DIAMANT-...	76	SPEC +
-----	----	---	----------------	----	--------

82 Measurement actually applies to the sum of the $\pi^+ \mu^- e^+$ and $\pi^- \mu^+ e^+$ modes. $\Gamma(\pi^- e^+ e^+)/\Gamma_{\text{total}}$ Γ_{45}/Γ

Test of total lepton number conservation.

VALUE	CL%	EVTS	DOCUMENT ID	TECN	CHG
$<6.4 \times 10^{-10}$	90	0	APPEL	00B	B865 +

• • • We do not use the following data for averages, fits, limits, etc. • • •

$<9.2 \times 10^{-9}$	90	0	DIAMANT-...	76	SPEC +
-----------------------	----	---	-------------	----	--------

$<1.5 \times 10^{-5}$	90	0	CHANG	68	HBC -
-----------------------	----	---	-------	----	-------

 $\Gamma(\pi^- \mu^+ \mu^+)/\Gamma_{\text{total}}$ Γ_{46}/Γ

Forbidden by total lepton number conservation.

VALUE	CL%	EVTS	DOCUMENT ID	TECN	CHG
$<1.1 \times 10^{-9}$	90	0	BATLEY	11A	NA48 ±

• • • We do not use the following data for averages, fits, limits, etc. • • •

$<3.0 \times 10^{-9}$	90	0	APPEL	00B	B865 +
-----------------------	----	---	-------	-----	--------

$<1.5 \times 10^{-4}$	90	0	83 LITTENBERG	92	HBC
-----------------------	----	---	---------------	----	-----

83 LITTENBERG 92 is from retroactive data analysis of CHANG 68 bubble chamber data.

 $\Gamma(\mu^+ \bar{\nu}_e)/\Gamma_{\text{total}}$ Γ_{47}/Γ

Forbidden by total lepton number conservation.

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
< 3.3	90	84	COOPER	82	HLBC Wideband ν beam

84 COOPER 82 limit on $\bar{\nu}_e$ observation is here interpreted as a limit on lepton number violation in the absence of mixing. $\Gamma(\pi^0 e^+ \bar{\nu}_e)/\Gamma_{\text{total}}$ Γ_{48}/Γ

Forbidden by total lepton number conservation.

VALUE	CL%	EVTS	DOCUMENT ID	TECN	COMMENT
< 0.003	90	85	COOPER	82	HLBC Wideband ν beam

85 COOPER 82 limit on $\bar{\nu}_e$ observation is here interpreted as a limit on lepton number violation in the absence of mixing. $\Gamma(\pi^+ \gamma)/\Gamma_{\text{total}}$ Γ_{49}/Γ

Violates angular momentum conservation and gauge invariance. Current interest in this decay is as a search for non-commutative space-time effects as discussed in ARTAMONOV 05 and for exotic physics such as a vacuum expectation value of a new vector field, non-local Superstring effects, or departures from Lorentz invariance, as discussed in ADLER 02B.

VALUE (units 10^{-9})	CL%	EVTS	DOCUMENT ID	TECN	CHG
< 2.3	90	0	ARTAMONOV	05	B949 +

• • • We do not use the following data for averages, fits, limits, etc. • • •

< 360	90	0	ADLER	02B	B787 +
-------	----	---	-------	-----	--------

<1400	90	0	ASANO	82	CNTR +
-------	----	---	-------	----	--------

<4000	90	0	86 KLEMS	71	OSPK +
-------	----	---	----------	----	--------

86 Test of model of Selleri, Nuovo Cimento **60A** 291 (1969).

NODE=S010R34

NODE=S010R34

NODE=S010R34

NODE=S010R39;LINKAGE=X

NODE=S010R69

NODE=S010R69

NODE=S010R69

NODE=S010R69;LINKAGE=X

NODE=S010R31

NODE=S010R31

NODE=S010R31

NODE=S010R70

NODE=S010R70

NODE=S010R70

NODE=S010R58;LINKAGE=L

NODE=S010R59

NODE=S010R59

NODE=S010R59

NODE=S010R59;LINKAGE=L

NODE=S010R34

NODE=S010R34

NODE=S010R34

NODE=S010R34;LINKAGE=K

K⁺ LONGITUDINAL POLARIZATION OF EMITTED μ^+

VALUE	CL%	DOCUMENT ID	TECN	CHG	COMMENT
<=0.990	90	87 AOKI	94	SPEC +	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
-0.990	90	IMAZATO	92	SPEC +	Repl. by AOKI 94
-0.970±0.047	88	YAMANAKA	86	SPEC +	
-1.0 ±0.1	88	CUTTS	69	SPRK +	
-0.96 ±0.12	88	COOMBES	57	CNTR +	

87 AOKI 94 measures $\xi P_\mu = -0.9996 \pm 0.0030 \pm 0.0048$. The above limit is obtained by summing the statistical and systematic errors in quadrature, normalizing to the physically significant region ($|\xi P_\mu| < 1$) and assuming that $\xi=1$, its maximum value.

88 Assumes $\xi=1$.

A REVIEW GOES HERE – Check our WWW List of Reviews

ENERGY DEPENDENCE OF K[±] DALITZ PLOT

$$|\text{matrix element}|^2 = 1 + gu + hu^2 + kv^2$$

where $u = (s_3 - s_0) / m_\pi^2$ and $v = (s_2 - s_1) / m_\pi^2$

LINEAR COEFFICIENT g FOR K[±] → π[±]π⁺π⁻

Some experiments use Dalitz variables x and y . In the comments we give a_y = coefficient of y term. See note above on "Dalitz Plot Parameters for $K \rightarrow 3\pi$ Decays." For discussion of the conversion of a_y to g , see the earlier version of the same note in the Review published in Physics Letters **111B** 70 (1982).

VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
-0.21134±0.00017	471M	89 BATLEY	07B	NA48 ±	
• • • We do not use the following data for averages, fits, limits, etc. • • •					
-0.2221 ±0.0065	225k	DEVAUX	77	SPEC +	$a_y = .2814 \pm .0082$
-0.199 ±0.008	81k	90 LUCAS	73	HBC -	$a_y = .252 \pm .011$
-0.2157 ±0.0028	750k	FORD	72	ASPK +	$a_y = .2734 \pm .0035$
-0.2186 ±0.0028	750k	FORD	72	ASPK -	$a_y = .2770 \pm .0035$
-0.200 ±0.009	39819	91 HOFFMASTER72	HLBC	+	
-0.196 ±0.012	17898	92 GRAUMAN	70	HLBC +	$a_y = .228 \pm .030$
-0.193 ±0.010	50919	MAST	69	HBC -	$a_y = .244 \pm .013$
-0.218 ±0.016	9994	93 BUTLER	68	HBC +	$a_y = .277 \pm .020$
-0.190 ±0.023	5778	93,94 MOSCOSO	68	HBC -	$a_y = .242 \pm .029$
-0.22 ±0.024	5428	93,94 ZINCHENKO	67	HBC +	$a_y = .28 \pm .03$
-0.220 ±0.035	1347	95 FERRO-LUZZI	61	HBC -	$a_y = .28 \pm .045$

89 Final state strong interaction and radiative corrections not included in the fit.

90 Quadratic dependence is required by K_L^0 experiments.

91 HOFFMASTER 72 includes GRAUMAN 70 data.

92 Emulsion data added — all events included by HOFFMASTER 72.

93 Experiments with large errors not included in average.

94 Also includes DBC events.

95 No radiative corrections included.

QUADRATIC COEFFICIENT h FOR K[±] → π[±]π⁺π⁻

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG
1.848±0.040	471M	96 BATLEY	07B	NA48 ±
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.06 ±1.43	225k	DEVAUX	77	SPEC +
1.87 ±0.62	750k	FORD	72	ASPK +
1.25 ±0.62	750k	FORD	72	ASPK -
-0.9 ±1.4	39819	HOFFMASTER72	HLBC	+
-0.1 ±1.2	50919	MAST	69	HBC -

96 Final state strong interaction and radiative corrections not included in the fit.

NODE=S010PL

NODE=S010PL

NODE=S010PL;LINKAGE=A

NODE=S010PL;LINKAGE=B

NODE=S010254

NODE=S010255

NODE=S010255

NODE=S010GT

NODE=S010GT

NODE=S010GT

OCCUR=2

NODE=S010GT;LINKAGE=BA

NODE=S010GT;LINKAGE=Q

NODE=S010GT;LINKAGE=H

NODE=S010GT;LINKAGE=G

NODE=S010GT;LINKAGE=L

NODE=S010GT;LINKAGE=Z

NODE=S010GT;LINKAGE=F

NODE=S010HT

NODE=S010HT

OCCUR=2

NODE=S010HT;LINKAGE=BA

QUADRATIC COEFFICIENT k FOR $K^\pm \rightarrow \pi^\pm \pi^+ \pi^-$

VALUE (units 10^{-3})	EVTS	DOCUMENT ID	TECN	CHG
- 4.63 ± 0.14	471M	97 BATLEY	07B	NA48 ±
• • • We do not use the following data for averages, fits, limits, etc. • • •				
- 20.5 ± 3.9	225k	DEVAUX	77	SPEC +
- 7.5 ± 1.9	750k	FORD	72	ASPK +
- 8.3 ± 1.9	750k	FORD	72	ASPK -
- 10.5 ± 4.5	39819	HOFFMASTER	72	HLBC +
- 14 ± 12	50919	MAST	69	HBC -

97 Final state strong interaction and radiative corrections not included in the fit.

 $(g_+ - g_-) / (g_+ + g_-)$ FOR $K^\pm \rightarrow \pi^\pm \pi^+ \pi^-$

This is a CP violating asymmetry between linear coefficients g_+ for $K^+ \rightarrow \pi^+ \pi^+ \pi^-$ decay and g_- for $K^- \rightarrow \pi^- \pi^+ \pi^-$ decay.

VALUE (units 10^{-4})	EVTS	DOCUMENT ID	TECN
- 1.5 ± 1.5 ± 1.6	3.1G	98 BATLEY	07E NA48
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1.7 ± 2.1 ± 2.0	1.7G	99 BATLEY	06 NA48
- 70.0 ± 53	3.2M	FORD	70 ASPK

98 BATLEY 07E includes data from BATLEY 06. Uses quadratic parametrization and value $g_+ + g_- = 2g$ from BATLEY 07B. This measurement neglects any possible charge asymmetries in higher order slope parameters h or k .

99 This measurement neglects any possible charge asymmetries in higher order slope parameters h or k .

LINEAR COEFFICIENT g FOR $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$

Unless otherwise stated, all experiments include terms quadratic in $(s_3 - s_0) / m_{\pi^+}^2$. See note above on "Dalitz Plot Parameters for $K \rightarrow 3\pi$ Decays."

See BATUSOV 98 for a discussion of the discrepancy between their result and others, especially BOLOTOV 86. At this time we have no way to resolve the discrepancy so we depend on the large scale factor as a warning.

VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
0.626 ± 0.007 OUR AVERAGE					
0.6259 ± 0.0043 ± 0.0093	493k	AKOPDZHAN..05B	TNF	±	
0.627 ± 0.004 ± 0.010	252k ^{100,101}	AJINENKO	03B	ISTR	-
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.736 ± 0.014 ± 0.012	33k	BATUSOV	98	SPEC +	
0.582 ± 0.021	43k	BOLOTOV	86	CALO -	
0.670 ± 0.054	3263	BRAUN	76B	HLBC +	
0.630 ± 0.038	5635	SHEAFF	75	HLBC +	
0.510 ± 0.060	27k	SMITH	75	WIRE +	
0.67 ± 0.06	1365	AUBERT	72	HLBC +	
0.544 ± 0.048	4048	DAVISON	69	HLBC +	Also emulsion

100 Measured using in-flight decays of the 25 GeV negative secondary beam.

101 They form new world averages $g_- = (0.617 \pm 0.018)$ and $g_+ = (0.684 \pm 0.033)$ which give $\Delta g_{\tau'} = 0.051 \pm 0.028$.

QUADRATIC COEFFICIENT h FOR $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$

VALUE	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
0.052 ± 0.008 OUR AVERAGE					
0.0551 ± 0.0044 ± 0.0086	493k	AKOPDZHAN..05B	TNF	±	
0.046 ± 0.004 ± 0.012	252k ¹⁰²	AJINENKO	03B	ISTR	-
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.128 ± 0.015 ± 0.024	33k	BATUSOV	98	SPEC +	
0.037 ± 0.024	43k	BOLOTOV	86	CALO -	
0.152 ± 0.082	3263	BRAUN	76B	HLBC +	
0.041 ± 0.030	5635	SHEAFF	75	HLBC +	
0.009 ± 0.040	27k	SMITH	75	WIRE +	
- 0.01 ± 0.08	1365	AUBERT	72	HLBC +	
0.026 ± 0.050	4048	DAVISON	69	HLBC +	Also emulsion

102 Measured using in-flight decays of the 25 GeV negative secondary beam.

NODE=S010KT

NODE=S010KT

OCCUR=2

NODE=S010KT;LINKAGE=BA

NODE=S010DG

NODE=S010DG

NODE=S010DG

NODE=S010DG;LINKAGE=BT

NODE=S010DG;LINKAGE=BA

NODE=S010GTP

NODE=S010GTP

NODE=S010GTP

NODE=S010GTP;LINKAGE=AI

NODE=S010GTP;LINKAGE=AJ

NODE=S010HTP

NODE=S010HTP

NODE=S010HTP;LINKAGE=AJ

QUADRATIC COEFFICIENT k FOR $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>
0.0054±0.0035 OUR AVERAGE			Error includes scale factor of 2.5.	
0.0082±0.0011±0.0014	493k	AKOPDZHAN..05B	TNF	±
0.001 ± 0.001 ± 0.002	252k	103 AJINENKO	03B ISTR	—
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.0197±0.0045±0.0029	33k	BATUSOV	98 SPEC	+

103 Measured using in-flight decays of the 25 GeV negative secondary beam.

($g_+ - g_-$) / ($g_+ + g_-$) FOR $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$ A nonzero value for this quantity indicates CP violation.

<u>VALUE (units 10^{-4})</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
1.8± 1.8 OUR AVERAGE			

1.8± 1.7±0.6	91.3M	104 BATLEY	07E NA48
2 ± 18 ± 5	619k	105 AKOPDZHAN..05	TNF

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.8± 2.2±1.3	47M	106 BATLEY	06A NA48
--------------	-----	------------	----------

104 BATLEY 07E includes data from BATLEY 06A. Uses quadratic parametrization and PDG 06 value $g = 0.626 \pm 0.007$ to obtain $g_+ - g_- = (2.2 \pm 2.1 \pm 0.7) \times 10^{-4}$. Neglects any possible charge asymmetries in higher order slope parameters h or k .105 Asymmetry obtained assuming that $g_+ + g_- = 2 \times 0.652$ (PDG 02) and that asymmetries in h and k are zero.106 Linear and quadratic slopes from PDG 04 are used. Any possible charge asymmetries in higher order slope parameters h or k are neglected.**ALTERNATIVE PARAMETRIZATIONS OF $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$ DALITZ PLOT**

The following functional form for the matrix element suggested by $\pi\pi$ rescattering in $K^+ \rightarrow \pi^+ \pi^+ \pi^- \rightarrow \pi^+ \pi^0 \pi^0$ is used for this fit (CABIBBO 04A, CABIBBO 05): Matrix element = $M_0 + M_1$ where $M_0 = 1 + (1/2)g_0 u + (1/2)h' u^2 + (1/2)k_0 v^2$ with $u = (s_3 - s_0)/(m_{\pi^+})^2$, $v = (s_2 - s_1)/(m_{\pi^+})^2$ and where M_1 takes into account the non-analytic piece due to pi pi rescattering amplitudes a_0 and a_2 ; The parameters g_0 and h' are related to the parameters g and h of the matrix element squared given in the previous section by the approximations $g_0 \sim g^{PDG}$ and $h' \sim h^{PDG} - (g/2)^2$ and $k_0 \sim k^{PDG}$.

In addition, we also consider the effective field theory framework of COLANGELO 06A and BISSEGGER 09 to extract g_{BB} and h'_{BB} .

LINEAR COEFFICIENT g_0 FOR $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>
0.6525±0.0009±0.0033	60M	107 BATLEY	09A NA48	±
• • • We do not use the following data for averages, fits, limits, etc. • • •				

0.645 ± 0.004 ± 0.009	23M	108 BATLEY	06B NA48	±
-----------------------	-----	------------	----------	---

107 This fit is obtained with the CABIBBO 05 matrix element in the $2\pi^0$ invariant mass squared range $0.074094 < m_{2\pi^0}^2 < 0.104244$ GeV 2 . Electromagnetic corrections and CHPT constraints for $\pi\pi$ phase shifts (a_0 and a_2) have been used. Also measured ($a_0 - a_2$) $m_{\pi^+} = 0.2646 \pm 0.0021 \pm 0.0023$, where k_0 was kept fixed in the fit at -0.0099 .108 Superseded by BATLEY 09A. This fit is obtained with the CABIBBO 05 matrix element in the $2\pi^0$ invariant mass squared range 0.074 GeV $^2 < m_{2\pi^0}^2 < 0.097$ GeV 2 , assuming $k = 0$ (no term proportional to $(s_2 - s_1)^2$) and excluding the kinematic region around the cusp ($m_{2\pi^0}^2 = (2m_{\pi^+})^2 \pm 0.000525$ GeV 2). Also $\pi\pi$ phase shifts a_0 and a_2 are measured: $(a_0 - a_2)m_{\pi^+} = 0.268 \pm 0.010 \pm 0.004 \pm 0.013$ (external) and $a_2 m_{\pi^+} = -0.041 \pm 0.022 \pm 0.014$.**QUADRATIC COEFFICIENT h' FOR $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$**

<u>VALUE</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>CHG</u>
-0.0433±0.0008±0.0026	60M	109 BATLEY	09A NA48	±
• • • We do not use the following data for averages, fits, limits, etc. • • •				

-0.047 ± 0.012 ± 0.011	23M	110 BATLEY	06B NA48	±
------------------------	-----	------------	----------	---

NODE=S010KTP
NODE=S010KTP

NODE=S010KTP;LINKAGE=AJ

NODE=S010DG0
NODE=S010DG0
NODE=S010DG0

NODE=S010DG0;LINKAGE=BT

NODE=S010DG0;LINKAGE=AK

NODE=S010DG0;LINKAGE=BA

NODE=S010257

NODE=S010257

NODE=S010G0
NODE=S010G0

NODE=S010G0;LINKAGE=BT

NODE=S010G0;LINKAGE=BA

NODE=S010HP
NODE=S010HP

109 This fit is obtained with the CABIBBO 05 matrix element in the $2\pi^0$ invariant mass squared range $0.074094 < m_{2\pi^0}^2 < 0.104244 \text{ GeV}^2$. Electromagnetic corrections and CHPT constraints for $\pi\pi$ phase shifts (a_0 and a_2) have been used. Also measured $(a_0 - a_2) m_{\pi^+} = 0.2646 \pm 0.0021 \pm 0.0023$, where k_0 was kept fixed in the fit at -0.0099 .

110 Superseded by BATLEY 09A. This fit is obtained with the CABIBBO 05 matrix element in the $2\pi^0$ invariant mass squared range $0.074 \text{ GeV}^2 < m_{2\pi^0}^2 < 0.097 \text{ GeV}^2$, assuming $k = 0$ (no term proportional to $(s_2 - s_1)^2$) and excluding the kinematic region around the cusp ($m_{2\pi^0}^2 = (2m_{\pi^+})^2 \pm 0.000525 \text{ GeV}^2$). Also $\pi\pi$ phase shifts a_0 and a_2 are measured: $(a_0 - a_2) m_{\pi^+} = 0.268 \pm 0.010 \pm 0.004 \pm 0.013$ (external) and $a_2 m_{\pi^+} = -0.041 \pm 0.022 \pm 0.014$.

QUADRATIC COEFFICIENT k_0 FOR $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$

VALUE	EVTS	DOCUMENT ID	TECN	CHG
0.0095 ± 0.00017 ± 0.00048	60M	111 BATLEY	09A NA48	±

111 Assumed $a_2 m_{\pi^+} = -0.0044$ in the fit.

LINEAR COEFFICIENT g_{BB} FOR $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$

VALUE	EVTS	DOCUMENT ID	TECN	CHG
0.6219 ± 0.0009 ± 0.0033	60M	112 BATLEY	09A NA48	±

112 This fit is obtained using parametrizations of COLANGELO 06A and BISSEGGER 09 in the $2\pi^0$ invariant mass squared range $0.074094 < m_{2\pi^0}^2 < 0.104244 \text{ GeV}^2$. Electromagnetic corrections and CHPT constraints for $\pi\pi$ phase shifts (a_0 and a_2) have been used. Also measured $(a_0 - a_2) m_{\pi^+} = 0.2633 \pm 0.0024 \pm 0.0024$, where k_0 was kept fixed in the fit at 0.0085.

QUADRATIC COEFFICIENT h_{BB} FOR $K^\pm \rightarrow \pi^\pm \pi^0 \pi^0$

VALUE	EVTS	DOCUMENT ID	TECN	CHG
-0.0520 ± 0.0009 ± 0.0026	60M	113 BATLEY	09A NA48	±

113 This fit is obtained using parametrizations of COLANGELO 06A and BISSEGGER 09 in the $2\pi^0$ invariant mass squared range $0.074094 < m_{2\pi^0}^2 < 0.104244 \text{ GeV}^2$. Electromagnetic corrections and CHPT constraints for $\pi\pi$ phase shifts (a_0 and a_2) have been used. Also measured $(a_0 - a_2) m_{\pi^+} = 0.2633 \pm 0.0024 \pm 0.0024$, where k_0 was kept fixed in the fit at 0.0085.

A REVIEW GOES HERE – Check our WWW List of Reviews

$K_{\ell 3}^\pm$ FORM FACTORS

In the form factor comments, the following symbols are used.

f_+ and f_- are form factors for the vector matrix element.

f_S and f_T refer to the scalar and tensor term.

$$f_0 = f_+ + f_- t / (m_{K^+}^2 - m_{\pi^0}^2)$$

t = momentum transfer to the π .

λ_+ and λ_0 are the linear expansion coefficients of f_+ and f_0 :

$$f_+(t) = f_+(0) (1 + \lambda_+ t / m_{\pi^+}^2)$$

For quadratic expansion

$$f_+(t) = f_+(0) (1 + \lambda'_+ t / m_{\pi^+}^2 + \frac{\lambda''_+}{2} t^2 / m_{\pi^+}^4)$$

as used by KTeV. If there is a non-vanishing quadratic term, then λ_+ represents an average slope, which is then different from λ'_+ .

NA48 and ISTRA quadratic expansion coefficients are converted with

$$\lambda'_+ \text{ PDG} = \lambda'_+ \text{ NA48} \text{ and } \lambda''_+ \text{ PDG} = 2 \lambda'_+ \text{ NA48}$$

$$\lambda'_+ \text{ PDG} = (\frac{m_{\pi^+}}{m_{\pi^0}})^2 \lambda'_+ \text{ ISTRA} \text{ and}$$

$$\lambda''_+ \text{ PDG} = 2 (\frac{m_{\pi^+}}{m_{\pi^0}})^4 \lambda'_+ \text{ ISTRA}$$

ISTRA linear expansion coefficients are converted with

$$\lambda'_+ \text{ PDG} = (\frac{m_{\pi^+}}{m_{\pi^0}})^2 \lambda'_+ \text{ ISTRA} \text{ and } \lambda_0 \text{ PDG} = (\frac{m_{\pi^+}}{m_{\pi^0}})^2 \lambda_0 \text{ ISTRA}$$

The pole parametrization is

$$f_+(t) = f_+(0) \left(\frac{M_V^2}{M_V^2 - t} \right)$$

$$f_0(t) = f_0(0) \left(\frac{M_S^2}{M_S^2 - t} \right)$$

NODE=S010HP;LINKAGE=BT

NODE=S010HP;LINKAGE=BA

NODE=S010K0F
NODE=S010K0F

NODE=S010K0F;LINKAGE=BT

NODE=S010GBB
NODE=S010GBB

NODE=S010GBB;LINKAGE=BT

NODE=S010HBB
NODE=S010HBB

NODE=S010HBB;LINKAGE=BT

NODE=S010259

NODE=S010260

NODE=S010260

where M_V and M_S are the vector and scalar pole masses.

The following abbreviations are used:

DP = Dalitz plot analysis.

PI = π spectrum analysis.

MU = μ spectrum analysis.

POL= μ polarization analysis.

BR = $K_{\mu 3}^{\pm}/K_{e 3}^{\pm}$ branching ratio analysis.

E = positron or electron spectrum analysis.

RC = radiative corrections.

λ_+ (LINEAR ENERGY DEPENDENCE OF f_+ IN $K_{e 3}^{\pm}$ DECAY)

These results are for a linear expansion only. See the next section for fits including a quadratic term. For radiative correction of the $K_{e 3}^{\pm}$ Dalitz plot, see GINSBERG 67, BECHERRAWY 70, CIRIGLIANO 02, CIRIGLIANO 04, and ANDRE 07. Results labeled OUR FIT are discussed in the review " $K_{\ell 3}^{\pm}$ and $K_{\ell 3}^0$ Form Factors" above. For earlier, lower statistics results, see the 2004 edition of this review, Physics Letters **B592** 1 (2004).

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
2.97 ± 0.05 OUR FIT	Assuming μ -e universality				
2.98 ± 0.05 OUR AVERAGE					
3.044 $\pm 0.083 \pm 0.074$	1.1M	AKOPDZANOV 09	TNF	\pm	
2.966 $\pm 0.050 \pm 0.034$	919k	114 YUSHCHENKO 04B	ISTR	—	DP
2.78 $\pm 0.26 \pm 0.30$	41k	SHIMIZU 00	SPEC	+	DP
2.84 $\pm 0.27 \pm 0.20$	32k	115 AKIMENKO 91	SPEC		PI, no RC
2.9 ± 0.4	62k	116 BOLOTOV 88	SPEC		PI, no RC
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3.06 $\pm 0.09 \pm 0.06$	550k	114,117 AJINENKO 03C	ISTR	—	DP
2.93 $\pm 0.15 \pm 0.2$	130k	117 AJINENKO 02	SPEC		DP

114 Rescaled to agree with our conventions as noted above.

115 AKIMENKO 91 state that radiative corrections would raise λ_+ by 0.0013.

116 BOLOTOV 88 state radiative corrections of GINSBERG 67 would raise λ_+ by 0.002.

117 Superseded by YUSHCHENKO 04B.

NODE=S010L+E
NODE=S010L+E

NODE=S010L+E

λ_+ (LINEAR ENERGY DEPENDENCE OF f_+ IN $K_{\mu 3}^{\pm}$ DECAY)

Results labeled OUR FIT are discussed in the review " $K_{\ell 3}^{\pm}$ and $K_{\ell 3}^0$ Form Factors" above. For earlier, lower statistics results, see the 2004 edition of this review, Physics Letters **B592** 1 (2004).

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
2.97 ± 0.05 OUR FIT	Assuming μ -e universality				
2.96 ± 0.17 OUR FIT	Not assuming μ -e universality				
2.96 $\pm 0.14 \pm 0.10$	540k	118 YUSHCHENKO 04	ISTR	—	DP
• • • We do not use the following data for averages, fits, limits, etc. • • •					
3.21 ± 0.45	112k	119 AJINENKO 03	ISTR	—	DP

118 Rescaled to agree with our conventions as noted above.

119 Superseded by YUSHCHENKO 04.

NODE=S010L+E;LINKAGE=SC
NODE=S010L+E;LINKAGE=D
NODE=S010L+E;LINKAGE=C
NODE=S010L+E;LINKAGE=AJ

NODE=S010L+M
NODE=S010L+M

NODE=S010L+M

NODE=S010L+M;LINKAGE=SC
NODE=S010L+M;LINKAGE=AJ

NODE=S010L0
NODE=S010L0

NODE=S010L0

λ_0 (LINEAR ENERGY DEPENDENCE OF f_0 IN $K_{\mu 3}^{\pm}$ DECAY)

Results labeled OUR FIT are discussed in the review " $K_{\ell 3}^{\pm}$ and $K_{\ell 3}^0$ Form Factors" above. For earlier, lower statistics results, see the 2004 edition of this review, Physics Letters **B592** 1 (2004).

VALUE (units 10^{-2})	$d\lambda_0/d\lambda_+$	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
1.95 ± 0.12 OUR FIT	Assuming μ -e universality					
1.96 ± 0.13 OUR FIT	Not assuming μ -e universality					
+1.96 $\pm 0.12 \pm 0.06$	-0.348	540k	120 YUSHCHENKO 04	ISTR	—	DP
• • • We do not use the following data for averages, fits, limits, etc. • • •						
+2.09 ± 0.45	-0.46	112k	121 AJINENKO 03	ISTR	—	DP
+1.9 ± 0.64		24k	122 HORIE 01	SPEC	+	BR
+1.9 ± 1.0	+0.03	55k	123 HEINTZE 77	SPEC	+	BR

120 Rescaled to agree with our conventions as noted above.

121 Superseded by YUSHCHENKO 04.

122 HORIE 01 assumes μ -e universality in $K_{\ell 3}^+$ decay and uses SHIMIZU 00 value $\lambda=0.0278 \pm 0.0040$ from $K_{e 3}^{\pm}$ decay.

123 HEINTZE 77 uses $\lambda_+ = 0.029 \pm 0.003$. $d\lambda_0/d\lambda_+$ estimated by us.

NODE=S010L0;LINKAGE=SC
NODE=S010L0;LINKAGE=AJ

NODE=S010L0;LINKAGE=HK

NODE=S010L0;LINKAGE=H

λ'_+ (LINEAR K_{e3}^\pm FORM FACTOR FROM QUADRATIC FIT)

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
2.485±0.163±0.034	919k	124,125	YUSHCHENKO04B	ISTR	— DP
• • • We do not use the following data for averages, fits, limits, etc. • • •					

3.07 ± 0.21 550k 124,126 AJINENKO 03C ISTR — DP

124 Rescaled to agree with our conventions as noted above.

125 YUSHCHENKO 04B λ'_+ and λ''_+ are strongly correlated with coefficient $\rho(\lambda'_+, \lambda''_+) = -0.95$.

126 Superseded by YUSHCHENKO 04B.

NODE=S010LPE
NODE=S010LPE **λ''_+ (QUADRATIC K_{e3}^\pm FORM FACTOR)**

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
0.192±0.062±0.071	919k	127,128	YUSHCHENKO04B	ISTR	— DP

• • • We do not use the following data for averages, fits, limits, etc. • • •

-0.5 ± 0.7 ± 1.5 550k 127,129 AJINENKO 03C ISTR — DP

127 Rescaled to agree with our conventions as noted above.

128 YUSHCHENKO 04B λ'_+ and λ''_+ are strongly correlated with coefficient $\rho(\lambda'_+, \lambda''_+) = -0.95$.

129 Superseded by YUSHCHENKO 04B.

NODE=S010LPE;LINKAGE=SC
NODE=S010LPE;LINKAGE=YU
NODE=S010LPE;LINKAGE=AJ **$|f_S/f_+|$ FOR K_{e3}^\pm DECAY**Ratio of scalar to f_+ couplings.

VALUE (units 10^{-2})	CL%	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
-0.3 ± 0.8 OUR AVERAGE						

-0.37 ± 0.66 ± 0.41 919k YUSHCHENKO04B ISTR — $\lambda'_+, \lambda''_+, f_S$ fit
0.2 ± 2.6 ± 1.4 41k SHIMIZU 00 SPEC + λ_+, f_S, f_T fit

• • • We do not use the following data for averages, fits, limits, etc. • • •

0.2 ± 2.0 ± 0.3 550k 130 AJINENKO 03C ISTR — λ_+, f_S, f_T fit
-1.9 ± 2.5 ± 1.6 130k 130 AJINENKO 02 SPEC λ_+, f_S fit
7.0 ± 1.6 ± 1.6 32k AKIMENKO 91 SPEC $\lambda_+, f_S, f_T, \phi$ fit
0 ± 10 2827 131 BRAUN 75 HLBC +
< 13 90 4017 CHIANG 72 OSPK +
 14^{+3}_{-4} 2707 131 STEINER 71 HLBC + $\lambda_+, f_S, f_T, \phi$ fit
< 23 90 BOTTERILL 68C ASPK
< 18 90 BELLOTTI 67B HLBC
< 30 95 KALMUS 67 HLBC +

130 Superseded by YUSHCHENKO 04B.

131 Statistical errors only.

NODE=S010LQE;LINKAGE=SC
NODE=S010LQE;LINKAGE=YU
NODE=S010LQE;LINKAGE=AJNODE=S010FS
NODE=S010FS
NODE=S010FS **$|f_T/f_+|$ FOR K_{e3}^\pm DECAY**Ratio of tensor to f_+ couplings.

VALUE (units 10^{-2})	CL%	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
-1.2 ± 2.3 OUR AVERAGE						

-1.2 ± 2.1 ± 1.1 919k YUSHCHENKO04B ISTR — $\lambda'_+, \lambda''_+, f_T$ fit
1 ± 14 ± 9 41k SHIMIZU 00 SPEC + λ_+, f_S, f_T fit

• • • We do not use the following data for averages, fits, limits, etc. • • •

2.1 ± 6.4 ± 2.6 550k 132 AJINENKO 03C ISTR — λ_+, f_S, f_T fit
-4.5 ± 6.0 ± 5.7 130k 132 AJINENKO 02 SPEC λ_+, f_T fit
 53^{+9}_{-10} ± 10 32k AKIMENKO 91 SPEC $\lambda_+, f_S, f_T, \phi$ fit
7 ± 37 2827 133 BRAUN 75 HLBC +
< 75 90 4017 CHIANG 72 OSPK +
24 ± 16 ± 14 2707 133 STEINER 71 HLBC + $\lambda_+, f_S, f_T, \phi$ fit
< 58 90 BOTTERILL 68C ASPK
< 58 90 BELLOTTI 67B HLBC
< 110 95 KALMUS 67 HLBC +NODE=S010FS;LINKAGE=AI
NODE=S010FS;LINKAGE=SENODE=S010FT
NODE=S010FT
NODE=S010FT

132 Superseded by YUSHCHENKO 04B.

133 Statistical errors only.

NODE=S010FT;LINKAGE=AJ
NODE=S010FT;LINKAGE=SE

f_s/f_+ FOR $K_{\mu 3}^\pm$ DECAY

Ratio of scalar to f_+ couplings.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
0.17±0.14±0.54	540k	134 YUSHCHENKO04	ISTR	–	DP
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.4 ± 0.5 ± 0.5	112k	135 AJINENKO	03	ISTR	– DP
134	The second error is the theoretical error from the uncertainty in the chiral perturbation theory prediction for λ_0 , ± 0.0053, combined in quadrature with the systematic error ± 0.0009.				
135	The second error is the theoretical error from the uncertainty in the chiral perturbation theory prediction for λ_0 . Superseded by YUSHCHENKO 04.				

f_T/f_+ FOR $K_{\mu 3}^\pm$ DECAY

Ratio of tensor to f_+ couplings.

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG	COMMENT
-0.07±0.71±0.20	540k	YUSHCHENKO04	ISTR	–	DP
• • • We do not use the following data for averages, fits, limits, etc. • • •					
-2.1 ± 2.8 ± 1.4	112k	136 AJINENKO	03	ISTR	– DP
2 ± 12	1585	BRAUN	75	HLBC	

136 The second error is the theoretical error from the uncertainty in the chiral perturbation theory prediction for λ_0 . Superseded by YUSHCHENKO 04.

NODE=S010FSM

NODE=S010FSM

NODE=S010FSM

NODE=S010FSM;LINKAGE=YU

NODE=S010FS;LINKAGE=AJ

NODE=S010FTM

NODE=S010FTM

NODE=S010FTM

NODE=S010FTM;LINKAGE=AJ

NODE=S010263

NODE=S010263

$K_{\ell 4}^\pm$ FORM FACTORS

Based on the parametrizations of AMOROS 99, the $K_{\ell 4}^\pm$ form factors can be expressed as

$$F_s = f_s + f'_s q^2 + f''_s q^4 + f'_e S_e / 4m_\pi^2$$

$$F_p = f_p$$

$$G_p = g_p + g'_p q^2$$

$$H_p = h_p$$

where $q^2 = (S_\pi / 4m_\pi^2) - 1$, S_π is the invariant mass squared of the dipion, and S_e is the invariant mass squared of the dilepton.

f_s FOR $K^\pm \rightarrow \pi^+ \pi^- e^\pm \nu$ DECAY

VALUE	EVTS	DOCUMENT ID	TECN	CHG
5.712±0.032 OUR AVERAGE				

[5.75 ± 0.08 OUR 2012 AVERAGE]

5.705±0.003±0.035	1.1M	137 BATLEY	12	NA48 ±
5.75 ± 0.02 ± 0.08	400k	138 PISLAK	03	B865 +

137 BATLEY 12 uses data collected in 2003–2004. The result is obtained from a measurement of $\Gamma(\pi^+ \pi^- e \nu) / \Gamma(\pi^+ \pi^- \pi^+)$ and assumed PDG 12 value of $\Gamma(\pi^+ \pi^- \pi^+) / \Gamma(5.59 \pm 0.04) \times 10^{-2}$.

138 Radiative corrections included. Using Roy equations and not including isospin breaking, PISLAK 03 obtains the following $\pi\pi$ scattering lengths $a_0^0 = 0.228 \pm 0.012 \pm 0.004^{+0.012}_{-0.016}$ (theor.) and $a_0^2 = -0.0365 \pm 0.0023 \pm 0.0008^{+0.0031}_{-0.0026}$ (theor.).

f'_s/f_s FOR $K^\pm \rightarrow \pi^+ \pi^- e^\pm \nu$ DECAY

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG
15.2±0.7±0.5	1.13M	139 BATLEY	10C	NA48 ±

• • • We do not use the following data for averages, fits, limits, etc. • • •

17.2±0.9±0.6	670k	140 BATLEY	08A	NA48 ±
--------------	------	------------	-----	--------

139 Radiative corrections included. Using Roy equations and including isospin breaking, BATLEY 10C obtains the following scattering lengths $a_0^0 = 0.2220 \pm 0.0128 \pm 0.0050 \pm 0.0037$ (theor.), $a_0^2 = -0.0432 \pm 0.0086 \pm 0.0034 \pm 0.0028$ (theor.). The correlation with $f''_s/f_s = -0.954$ and with $f'_e/f_s = 0.080$. Supersedes BATLEY 08A.

140 Radiative corrections included. Using Roy equations and not including isospin breaking, BATLEY 08A obtains the following $\pi\pi$ scattering length $a_0^0 = 0.233 \pm 0.016 \pm 0.007$, $a_0^2 = -0.0471 \pm 0.011 \pm 0.004$.

NODE=S010FSF

NODE=S010FSF

NEW

NODE=S010FSF;LINKAGE=BA

NODE=S010FSF;LINKAGE=PI

NODE=S010RSP

NODE=S010RSP

NODE=S010RSP;LINKAGE=BA

NODE=S010RSP;LINKAGE=BT

f''_s/f_s FOR $K^\pm \rightarrow \pi^+\pi^- e^\pm\nu$ DECAY

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG
-7.3±0.7±0.6	1.13M	141 BATLEY	10C NA48	±
• • • We do not use the following data for averages, fits, limits, etc. • • •				

-9.0±0.9±0.7 670k 142 BATLEY 08A NA48 ±

141 Radiative corrections included. Using Roy equations and including isospin breaking, BATLEY 10C obtains the following scattering lengths $a_0^0 = 0.2220 \pm 0.0128 \pm 0.0050 \pm 0.0037$ (theor.), $a_0^2 = -0.0432 \pm 0.0086 \pm 0.0034 \pm 0.0028$ (theor.). The correlation with $r'_s/f_s = -0.954$ and with $f'_e/f_s = 0.019$. Supersedes BATLEY 08A.

142 Radiative corrections included. Using Roy equations and not including isospin breaking, BATLEY 08A obtains the following $\pi\pi$ scattering length $a_0^0 = 0.233 \pm 0.016 \pm 0.007$ $a_0^2 = -0.0471 \pm 0.011 \pm 0.004$.

 f'_e/f_s FOR $K^\pm \rightarrow \pi^+\pi^- e^\pm\nu$ DECAY

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG
6.8±0.6±0.7	1.13M	143 BATLEY	10C NA48	±
• • • We do not use the following data for averages, fits, limits, etc. • • •				

8.1±0.8±0.9 670k 144 BATLEY 08A NA48 ±

143 Radiative corrections included. Using Roy equations and including isospin breaking, BATLEY 10C obtains the following scattering lengths $a_0^0 = 0.2220 \pm 0.0128 \pm 0.0050 \pm 0.0037$ (theor.), $a_0^2 = -0.0432 \pm 0.0086 \pm 0.0034 \pm 0.0028$ (theor.). The correlation with $r'_s/f_s = 0.080$ and with $f''_s/f_s = 0.019$. Supersedes BATLEY 08A.

144 Radiative corrections included. Using Roy equations and not including isospin breaking, BATLEY 08A obtains the following $\pi\pi$ scattering length $a_0^0 = 0.233 \pm 0.016 \pm 0.007$ $a_0^2 = -0.0471 \pm 0.011 \pm 0.004$.

 f_p/f_s FOR $K^\pm \rightarrow \pi^+\pi^- e^\pm\nu$ DECAY

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG
-4.8±0.3±0.4	1.13M	145 BATLEY	10C NA48	±
• • • We do not use the following data for averages, fits, limits, etc. • • •				

-4.8±0.4±0.4 670k 146 BATLEY 08A NA48 ±

145 Radiative corrections included. Using Roy equations and including isospin breaking, BATLEY 10C obtains the following scattering lengths $a_0^0 = 0.2220 \pm 0.0128 \pm 0.0050 \pm 0.0037$ (theor.), $a_0^2 = -0.0432 \pm 0.0086 \pm 0.0034 \pm 0.0028$ (theor.). Supersedes BATLEY 08A.

146 Radiative corrections included. Using Roy equations and not including isospin breaking, BATLEY 08A obtains the following $\pi\pi$ scattering length $a_0^0 = 0.233 \pm 0.016 \pm 0.007$ $a_0^2 = -0.0471 \pm 0.011 \pm 0.004$.

 g_p/f_s FOR $K^\pm \rightarrow \pi^+\pi^- e^\pm\nu$ DECAY

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG
86.8±1.0±1.0	1.13M	147 BATLEY	10C NA48	±
• • • We do not use the following data for averages, fits, limits, etc. • • •				

87.3±1.3±1.2 670k 148 BATLEY 08A NA48 ±

80.9±0.9±1.2 400k 149 PISLAK 03 B865 ±

147 Radiative corrections included. Using Roy equations and including isospin breaking, BATLEY 10C obtains the following scattering lengths $a_0^0 = 0.2220 \pm 0.0128 \pm 0.0050 \pm 0.0037$ (theor.), $a_0^2 = -0.0432 \pm 0.0086 \pm 0.0034 \pm 0.0028$ (theor.). Supersedes BATLEY 08A. The correlation with $g'_p/f_s = -0.914$. Supersedes BATLEY 08A.

148 Radiative corrections included. Using Roy equations and not including isospin breaking, BATLEY 08A obtains the following $\pi\pi$ scattering length $a_0^0 = 0.233 \pm 0.016 \pm 0.007$ $a_0^2 = -0.0471 \pm 0.011 \pm 0.004$.

149 Radiative corrections included. Using Roy equations PISLAK 03 obtains the following scattering lengths $a_0^0 = 0.203 \pm 0.033 \pm 0.004$, $a_0^2 = -0.055 \pm 0.023 \pm 0.003$.

NODE=S010RPB
NODE=S010RPB

NODE=S010RPB;LINKAGE=BA

NODE=S010RPB;LINKAGE=BT

NODE=S010REF
NODE=S010REF

NODE=S010REF;LINKAGE=BA

NODE=S010REF;LINKAGE=BT

NODE=S010RPF
NODE=S010RPF

NODE=S010RPF;LINKAGE=BA

NODE=S010RPF;LINKAGE=BT

NODE=S010RGF
NODE=S010RGF

NODE=S010RGF;LINKAGE=BA

NODE=S010RGF;LINKAGE=BT

NODE=S010RGF;LINKAGE=PI

g_p/f_s FOR $K^\pm \rightarrow \pi^+ \pi^- e^\pm \nu$ DECAY

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG
$8.9 \pm 1.7 \pm 1.3$	1.13M	150 BATLEY	10C NA48	±
• • • We do not use the following data for averages, fits, limits, etc. • • •				
8.1 \pm 2.2 \pm 1.5	670k	151 BATLEY	08A NA48	±
12.0 \pm 1.9 \pm 0.7	400k	152 PISLAK	03 B865	±

150 Radiative corrections included. Using Roy equations and including isospin breaking, BATLEY 10C obtains the following scattering lengths $a_0^0 = 0.2220 \pm 0.0128 \pm 0.0050 \pm 0.0037$ (theor.), $a_0^2 = -0.0432 \pm 0.0086 \pm 0.0034 \pm 0.0028$ (theor.). The correlation with $g_p/f_s = -0.914$. Supersedes BATLEY 08A.

151 Radiative corrections included. Using Roy equations and not including isospin breaking, BATLEY 08A obtains the following $\pi\pi$ scattering length $a_0^0 = 0.233 \pm 0.016 \pm 0.007$, $a_0^2 = -0.0471 \pm 0.011 \pm 0.004$.

152 Radiative corrections included. Using Roy equations PISLAK 03 obtains the following scattering lengths $a_0^0 = 0.203 \pm 0.033 \pm 0.004$, $a_0^2 = -0.055 \pm 0.023 \pm 0.003$.

 h_p/f_s FOR $K^\pm \rightarrow \pi^+ \pi^- e^\pm \nu$ DECAY

VALUE (units 10^{-2})	EVTS	DOCUMENT ID	TECN	CHG
$-39.8 \pm 1.5 \pm 0.8$	1.13M	153 BATLEY	10C NA48	±
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-41.1 \pm 1.9 \pm 0.8	670k	154 BATLEY	08A NA48	±
-51.3 \pm 3.3 \pm 3.5	400k	155 PISLAK	03 B865	±

153 Radiative corrections included. Using Roy equations and including isospin breaking, BATLEY 10C obtains the following scattering lengths $a_0^0 = 0.2220 \pm 0.0128 \pm 0.0050 \pm 0.0037$ (theor.), $a_0^2 = -0.0432 \pm 0.0086 \pm 0.0034 \pm 0.0028$ (theor.). Supersedes BATLEY 08A.

154 Radiative corrections included. Using Roy equations and not including isospin breaking, BATLEY 08A obtains the following $\pi\pi$ scattering length $a_0^0 = 0.233 \pm 0.016 \pm 0.007$, $a_0^2 = -0.0471 \pm 0.011 \pm 0.004$.

155 Radiative corrections included. Using Roy equations PISLAK 03 obtains the following scattering lengths $a_0^0 = 0.203 \pm 0.033 \pm 0.004$, $a_0^2 = -0.055 \pm 0.023 \pm 0.003$.

DECAY FORM FACTOR FOR $K^\pm \rightarrow \pi^0 \pi^0 e^\pm \nu$

Given in BOLOTOV 86B, BARMIN 88B, and SHIMIZU 04.

 $K^\pm \rightarrow \ell^\pm \nu \gamma$ FORM FACTORS

For definitions of the axial-vector F_A and vector F_V form factor, see the "Note on $\pi^\pm \rightarrow \ell^\pm \nu \gamma$ and $K^\pm \rightarrow \ell^\pm \nu \gamma$ Form Factors" in the π^\pm section. In the kaon literature, often different definitions $a_K = F_A/m_K$ and $\nu_K = F_V/m_K$ are used.

 $F_A + F_V$, SUM OF AXIAL-VECTOR AND VECTOR FORM FACTOR FOR $K \rightarrow e \nu e \gamma$

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
0.133 ± 0.008 OUR AVERAGE				Error includes scale factor of 1.3. See the ideogram below.
0.125 \pm 0.007 \pm 0.001	1.4K	156 AMBROSINO 09E	KLOE	E_γ in 10–250 MeV, $p_e > 200$ MeV/c
0.147 \pm 0.011	51	157 HEINTZE	79 SPEC	
0.150 \pm 0.018 -0.023	56	158 HEARD	75 SPEC	

156 Vector form factor fitted with a linear function, $V(x) = F_V (1 + \lambda(1-x))$, $x = 2E_\gamma/m_K$. The fitted value of $\lambda = 0.38 \pm 0.20 \pm 0.02$ with a correlation of -0.93 between ($F_V + F_A$) and λ .

157 HEINTZE 79 quotes absolute value of $|F_A + F_V| \sin\theta_C$. We use $\sin\theta_C = V_{us} = 0.2205$.

158 HEARD 75 quotes absolute value of $|F_A + F_V| \sin\theta_C$. We use $\sin\theta_C = V_{us} = 0.2205$.

NODE=S010RGP
NODE=S010RGP

NODE=S010RGP;LINKAGE=BA

NODE=S010RGP;LINKAGE=BT

NODE=S010RGP;LINKAGE=PI

NODE=S010RHP
NODE=S010RHP

NODE=S010RHP;LINKAGE=BA

NODE=S010RHP;LINKAGE=BT

NODE=S010RHP;LINKAGE=PI

NODE=S010KF4
NODE=S010KF4
NODE=S010KF4

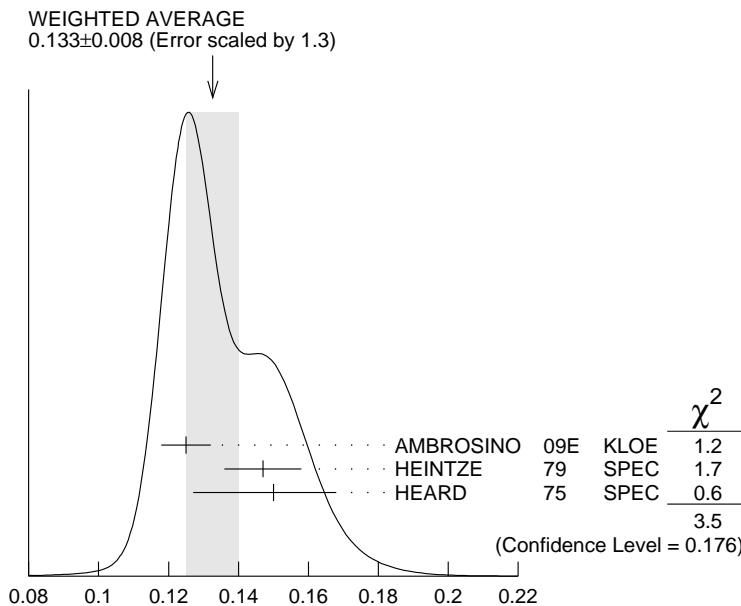
NODE=S010265

NODE=S010265

NODE=S010F+E
NODE=S010F+E

NODE=S010F+E;LINKAGE=AM

NODE=S010F+E;LINKAGE=B
NODE=S010F+E;LINKAGE=C



$F_A + F_V$, SUM OF AXIAL-VECTOR AND VECTOR FORM FACTOR FOR $K \rightarrow e\nu_e\gamma$

$F_A + F_V$, SUM OF AXIAL-VECTOR AND VECTOR FORM FACTOR FOR $K \rightarrow \mu\nu_\mu\gamma$

VALUE	CL%	EVTS	DOCUMENT ID	TECN	CHG
0.165±0.007±0.011		2588	159 ADLER	00B B787	+

• • • We do not use the following data for averages, fits, limits, etc. • • •

-1.2 to 1.1	90	DEMIDOV	90	XEBC
< 0.23	90	159 AKIBA	85	SPEC

159 Quotes absolute value. Sign not determined.

NODE=S010F+M
NODE=S010F+M

$F_A - F_V$, DIFFERENCE OF AXIAL-VECTOR AND VECTOR FORM FACTOR FOR $K \rightarrow e\nu_e\gamma$

VALUE	EVTS	DOCUMENT ID	TECN
<0.49	90	160 HEINTZE	79 SPEC

160 HEINTZE 79 quotes $|F_A - F_V| < \sqrt{11} |F_A + F_V|$.

NODE=S010F+M;LINKAGE=A

$F_A - F_V$, DIFFERENCE OF AXIAL-VECTOR AND VECTOR FORM FACTOR FOR $K \rightarrow \mu\nu_\mu\gamma$

VALUE	CL%	EVTS	DOCUMENT ID	TECN	CHG
-0.24 to 0.04	90	2588	ADLER	00B B787	+

• • • We do not use the following data for averages, fits, limits, etc. • • •

-2.2 to 0.6	90	DEMIDOV	90	XEBC
-2.5 to 0.3	90	AKIBA	85	SPEC

NODE=S010F-E
NODE=S010F-E

NODE=S010F-E;LINKAGE=B

NODE=S010F-M
NODE=S010F-M

K^\pm CHARGE RADIUS

VALUE (fm)	DOCUMENT ID	COMMENT
0.560±0.031 OUR AVERAGE		
0.580±0.040	AMENDOLIA 86B	$K_e \rightarrow K_e$
0.530±0.050	DALLY 80	$K_e \rightarrow K_e$
• • • We do not use the following data for averages, fits, limits, etc. • • •		
0.620±0.037	BLATNIK 79	VMD + dispersion relations

NODE=S010CR

NODE=S010CR

NODE=S010206

CP VIOLATION TESTS IN K^+ AND K^- DECAYS

$$\Delta(K_{\pi ee}^\pm) = \frac{\Gamma(K_{\pi ee}^+) - \Gamma(K_{\pi ee}^-)}{\Gamma(K_{\pi ee}^+) + \Gamma(K_{\pi ee}^-)}$$

VALUE (units 10^{-2})	DOCUMENT ID	TECN
-2.2±1.5±0.6	161 BATLEY 09	NA48

NODE=S010CPE
NODE=S010CPE

161 This implies an upper limit of 2.1×10^{-2} at 90% CL.

NODE=S010CPE;LINKAGE=BA

$$\Delta(K_{\pi\mu\mu}^{\pm}) = \frac{\Gamma(K_{\pi\mu\mu}^{+}) - \Gamma(K_{\pi\mu\mu}^{-})}{\Gamma(K_{\pi\mu\mu}^{+}) + \Gamma(K_{\pi\mu\mu}^{-})}$$

VALUE DOCUMENT ID TECN

0.010±0.023 OUR AVERAGE

0.011±0.023	162	BATLEY	11A	NA48
-0.02 ± 0.11	± 0.04	PARK	02	HYCP

162 This corresponds to the asymmetry upper limit of $< 2.9 \times 10^{-2}$ at 90% CL.

$$\Delta(K_{\pi\pi\gamma}^{\pm}) = \frac{\Gamma(K_{\pi\pi\gamma}^{+}) - \Gamma(K_{\pi\pi\gamma}^{-})}{\Gamma(K_{\pi\pi\gamma}^{+}) + \Gamma(K_{\pi\pi\gamma}^{-})}$$

VALUE (units 10^{-3}) EVTS DOCUMENT ID TECN

0.0±1.0±0.6 1M 163 BATLEY 10A NA48

163 This value implies the upper bound for this asymmetry 1.5×10^{-3} at 90% CL.

FORWARD-BACKWARD ASYMMETRY IN K^{\pm} DECAYS

$$A_{FB}(K_{\pi\mu\mu}^{\pm}) = \frac{\Gamma(\cos(\theta_{K\mu}) > 0) - \Gamma(\cos(\theta_{K\mu}) < 0)}{\Gamma(\cos(\theta_{K\mu}) > 0) + \Gamma(\cos(\theta_{K\mu}) < 0)}$$

VALUE CL% DOCUMENT ID TECN

<2.3 × 10⁻² 90 164 BATLEY 11A NA48

164 BATLEY 11A gives a corresponding value of the asymmetry $A_{FB} = (-2.4 \pm 1.8) \times 10^{-2}$.

T VIOLATION TESTS IN K^+ AND K^- DECAYS

P_T in $K^+ \rightarrow \pi^0 \mu^+ \nu_\mu$

T-violating muon polarization. Sensitive to new sources of CP violation beyond the Standard Model.

VALUE (units 10^{-3}) EVTS DOCUMENT ID TECN CHG

-1.7±2.3±1.1 165 ABE 04F K246 +

• • • We do not use the following data for averages, fits, limits, etc. • • •

-4.2±4.9±0.9 3.9M ABE 99S K246 +

165 Includes three sets of data: 96-97 (ABE 99S), 98, and 99-00 totaling about three times the ABE 99S data sample. Corresponds to $P_T < 5.0 \times 10^{-3}$ at 90% CL.

P_T in $K^+ \rightarrow \mu^+ \nu_\mu \gamma$

T-violating muon polarization. Sensitive to new sources of CP violation beyond the Standard Model.

VALUE (units 10^{-2}) EVTS DOCUMENT ID TECN CHG

-0.64±1.85±0.10 114k 166 ANISIMOVS...03 K246 +

166 Muons stopped and polarization measured from decay to positrons.

$\text{Im}(\xi)$ in $K^+ \rightarrow \pi^0 \mu^+ \nu_\mu$ DECAY (from transverse μ pol.)

Test of T reversal invariance.

VALUE EVTS DOCUMENT ID TECN CHG COMMENT

-0.006 ± 0.008 OUR AVERAGE

-0.0053±0.0071±0.0036 167 ABE 04F K246 +

-0.016 ± 0.025 20M CAMPBELL 81 CNTR + Pol.

• • • We do not use the following data for averages, fits, limits, etc. • • •

-0.013 ± 0.016 ± 0.003 3.9M ABE 99S CNTR + $p_T K^+$ at rest

167 Includes three sets of data: 96-97 (ABE 99S), 98, and 99-00 totaling about three times the ABE 99S data sample. Corresponds to $\text{Im}(\xi) < 0.016$ at 90% CL.

K^\pm REFERENCES

BATLEY	12	PL B715 105	J.R. Batley <i>et al.</i>	(NA48/2 Collab.)
PDG	12	PR D86 010001	J. Beringer <i>et al.</i>	(PDG Collab.)
BATLEY	11A	PL B697 107	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)
LAZZERONI	11	PL B698 105	C. Lazzeroni <i>et al.</i>	(CERN NA62 Collab.)
ADLER	10	PR D81 092001	S. Adler <i>et al.</i>	(BNL E787 Collab.)
BATLEY	10A	EPJ C68 75	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)
BATLEY	10C	EPJ C70 635	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)
PDG	10	JPG 37 075021	K. Nakamura <i>et al.</i>	(PDG Collab.)
PISLAK	10A	PRL 105 019901E	S. Pislak <i>et al.</i>	(BNL E865 Collab.)
AKOPDZANOV	09	PAN 71 2074	G.A. Akopdzanov <i>et al.</i>	(IHEP)

Translated from YAF 71 2108.

(NA48/2 Collab.)
(PDG Collab.)
(CERN NA48/2 Collab.)
(CERN NA62 Collab.)
(BNL E787 Collab.)
(CERN NA48/2 Collab.)
(CERN NA48/2 Collab.)
(BNL E865 Collab.)
(IHEP)

NODE=S010CP

NODE=S010CP

NODE=S010CP;LINKAGE=BA

NODE=S010CPG

NODE=S010CPG

NODE=S010CPG;LINKAGE=BA

NODE=S010208

NODE=S010AFB

NODE=S010AFB

NODE=S010AFB;LINKAGE=BA

NODE=S010280

NODE=S010PTM

NODE=S010PTM

NODE=S010PTM

NODE=S010PTM;LINKAGE=AB

NODE=S010PT

NODE=S010PT

NODE=S010PT

NODE=S010PT;LINKAGE=AN

NODE=S010IXI

NODE=S010IXI

NODE=S010IXI

NODE=S010IXI;LINKAGE=AB

NODE=S010

REFID=54203

REFID=54066

REFID=53688

REFID=16669

REFID=53319

REFID=53321

REFID=53567

REFID=53229

REFID=53338

REFID=52654

AMBROSINO	09E	EPJ C64 627	F. Ambrosino <i>et al.</i>	(KLOE Collab.)	REFID=53075
Also		EPJ C65 703 (errat)	F. Ambrosino <i>et al.</i>	(KLOE Collab.)	REFID=53237
BATLEY	09	PL B677 246	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=52840
BATLEY	09A	EPJ C64 589	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=53073
BISSEGGER	09	NP B806 178	M. Bissegger <i>et al.</i>		REFID=53248
AMBROSINO	08	JHEP 0801 073	F. Ambrosino <i>et al.</i>	(KLOE Collab.)	REFID=52210
AMBROSINO	08A	JHEP 0802 098	F. Ambrosino <i>et al.</i>	(KLOE Collab.)	REFID=52211
AMBROSINO	08E	PL B666 305	F. Ambrosino <i>et al.</i>	(KLOE Collab.)	REFID=52466
ARTAMONOV	08	PRD 101 191802	A.V. Artamonov <i>et al.</i>	(BNL E949 Collab.)	REFID=52566
Also		PR D79 092004	A.V. Artamonov <i>et al.</i>	(BNL E949 Collab.)	REFID=52811
BATLEY	08	PL B659 493	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=52102
BATLEY	08A	EPJ C54 411	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=52487
AKIMENKO	07	PAN 70 702	S.A. Akimenko <i>et al.</i>	(ISTRAP+ Collab.)	REFID=51830
		Translated from YAF 70 734.			
ANDRE	07	ANP 322 2518	T. Andre	(EFI)	REFID=50524
BATLEY	07A	EPJ C50 329	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=51763
Also		EPJ C52 1021 (errat)	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=52038
BATLEY	07B	PL B649 349	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=51821
BATLEY	07E	EPJ C52 875	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=52037
TCHIKILEV	07	PAN 70 29	O.G. Tchikilev <i>et al.</i>	(ISTRAP+ Collab.)	REFID=51653
ALIEV	06	EPJ C46 61	M.A. Aliev <i>et al.</i>	(KEK E470 Collab.)	REFID=51225
AMBROSINO	06A	PL B632 76	F. Ambrosino <i>et al.</i>	(KLOE Collab.)	REFID=51013
BATLEY	06	PL B634 474	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=51065
BATLEY	06A	PL B638 22	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=51257
Also		PL B640 297 (errat)	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=51380
BATLEY	06B	PL B633 173	J.R. Batley <i>et al.</i>	(CERN NA48/2 Collab.)	REFID=51071
COLANGELO	06A	PL B638 187	G. Colangelo <i>et al.</i>		REFID=53247
MA	06	PR D73 037101	H. Ma <i>et al.</i>	(BNL E865 Collab.)	REFID=51097
PDG	06	JPG 33 1	W.-M. Yao <i>et al.</i>	(PDG Collab.)	REFID=51004
SHIMIZU	06	PL B633 190	S. Shimizu <i>et al.</i>	(KEK E470 Collab.)	REFID=51066
UVAROV	06	PAN 69 26	V.A. Uvarov <i>et al.</i>	(ISTRAP+ Collab.)	REFID=51067
AKOPDZHANOV	05	EPJ C40 343	G.A. Akopdzhanyan <i>et al.</i>	(IHEP)	REFID=50674
Also		PAN 68 948	G.A. Akopdzhanyan <i>et al.</i>	(IHEP)	REFID=50869
		Translated from YAF 68 986.			
AKOPDZHANOV	05B	JETPL 82 675	G.A. Akopdzhanyan <i>et al.</i>	(IHEP)	REFID=51098
		Translated from ZETFP 82 771.			
ARTAMONOV	05	PL B623 192	A.V. Artamonov <i>et al.</i>	(BNL E949 Collab.)	REFID=50568
CABIBBO	05	JHEP 0503 021	N. Cabibbo, G. Isidori	(CERN, ROMAI, FRAS)	REFID=51070
SHER	05	PR D72 012005	A. Sher <i>et al.</i>	(BNL E865 Collab.)	REFID=50707
ABE	04F	PRL 93 131601	M. Abe <i>et al.</i>	(KEK E246 Collab.)	REFID=50083
Also		PR D73 072005	M. Abe <i>et al.</i>	(KEK E246 Collab.)	REFID=51110
ADLER	04	PR D70 037102	S. Adler <i>et al.</i>	(BNL E787 Collab.)	REFID=50053
ALOISIO	04A	PL B597 139	A. Aloisio <i>et al.</i>	(KLOE Collab.)	REFID=50110
ANISIMOVSKY	04	PRL 93 031801	V.V. Anisimovsky <i>et al.</i>	(BNL E949 Collab.)	REFID=49992
Also		PR D77 052003	S. Adler <i>et al.</i>	(BNL E949 Collab.)	REFID=52336
CABIBBO	04A	PRL 93 121801	N. Cabibbo	(CERN, ROMAI)	REFID=51069
CIRIGLIANO	04	EPJ C35 53	V. Cirigliano, H. Neufeld, H. Pichl	(CIT, VALE+)	REFID=49972
PDG	04	PL B592 1	S. Eidelman <i>et al.</i>	(PDG Collab.)	REFID=49653
SHIMIZU	04	PR D70 037101	S. Shimizu <i>et al.</i>	(KEK E470 Collab.)	REFID=50052
YUSHCHENKO	04	PL B581 31	O.P. Yushchenko <i>et al.</i>	(INRM, INRM)	REFID=49728
YUSHCHENKO	04B	PL B589 111	O.P. Yushchenko <i>et al.</i>	(INRM)	REFID=49729
AJINENKO	03	PAN 66 105	I.V. Ajinenko <i>et al.</i>	(IHEP, INRM)	REFID=49459
		Translated from YAF 66 107.			
AJINENKO	03B	PL B567 159	I.V. Ajinenko <i>et al.</i>	(IHEP, INRM)	REFID=49516
AJINENKO	03C	PL B574 14	I.V. Ajinenko <i>et al.</i>	(IHEP, INRM)	REFID=49804
ALIEV	03	PL B554 7	M.A. Aliev <i>et al.</i>	(KEK E470 Collab.)	REFID=49286
ANISIMOVSKY	03	PL B562 166	V.V. Anisimovsky <i>et al.</i>		REFID=49450
PISLAK	03	PR D67 072004	S. Pislak <i>et al.</i>	(BNL E865 Collab.)	REFID=49344
Also		PR D81 119903E	S. Pislak <i>et al.</i>	(BNL E865 Collab.)	REFID=53337
SHER	03	PRL 91 261802	A. Sher <i>et al.</i>	(BNL E865 Collab.)	REFID=49965
ADLER	02	PRL 88 041803	S. Adler <i>et al.</i>	(BNL E787 Collab.)	REFID=48538
ADLER	02B	PR D65 052009	S. Adler <i>et al.</i>	(BNL E787 Collab.)	REFID=48610
ADLER	02C	PL B537 211	S. Adler <i>et al.</i>	(BNL E787 Collab.)	REFID=48768
AJINENKO	02	PAN 65 2064	I.V. Ajinenko <i>et al.</i>	(IHEP, INRM)	REFID=49096
		Translated from YAF 65 2125.			
CIRIGLIANO	02	EPJ C23 121	V. Cirigliano <i>et al.</i>	(VIEN, VALE, MARS)	REFID=50523
PARK	02	PRL 88 111801	H.K. Park <i>et al.</i>	(FNAL HyperCP Collab.)	REFID=48700
PDG	02	PR D66 010001	K. Hagiwara <i>et al.</i>		REFID=48632
POBLAQUEV	02	PRL 89 061803	A.A. Poblaquev <i>et al.</i>	(BNL E865 Collab.)	REFID=48756
ADLER	01	PR D63 032004	S. Adler <i>et al.</i>	(BNL E787 Collab.)	REFID=48050
HORIE	01	PL B513 311	K. Horie <i>et al.</i>	(KEK E426 Collab.)	REFID=48190
PISLAK	01	PRL 87 221801	S. Pislak <i>et al.</i>	(BNL E865 Collab.)	REFID=48433
Also		PR D67 072004	S. Pislak <i>et al.</i>	(BNL E865 Collab.)	REFID=49344
Also		PRL 105 019901E	S. Pislak <i>et al.</i>	(BNL E865 Collab.)	REFID=53338
ADLER	00	PRL 84 3768	S. Adler <i>et al.</i>	(BNL E787 Collab.)	REFID=47539
ADLER	00B	PL B58 2256	S. Adler <i>et al.</i>	(BNL E787 Collab.)	REFID=47745
ADLER	00C	PRL 85 4856	S. Adler <i>et al.</i>	(BNL E787 Collab.)	REFID=47876
APPEL	00	PRL 85 2450	R. Appel <i>et al.</i>	(BNL 865 Collab.)	REFID=47754
Also		Theory, Yale Univ.	D.R. Bergman		REFID=48055
APPEL	00B	PRL 85 2877	S. Pislak		REFID=48056
MA	00	PRL 84 2580	R. Appel <i>et al.</i>	(BNL 865 Collab.)	REFID=47770
PDG	00	EPJ C15 1	H. Ma <i>et al.</i>	(BNL 865 Collab.)	REFID=47538
SHIMIZU	00	PL B495 33	D.E. Groom <i>et al.</i>		REFID=47469
ABE	99S	PRL 83 4253	S. Shimizu <i>et al.</i>	(KEK E246 Collab.)	REFID=47916
AMOROS	99	JPG 25 1607	M. Abe <i>et al.</i>	(KEK E246 Collab.)	REFID=47273
APPEL	99	PRL 83 4482	G. Amoros, J. Bijnens	(LUND, HELS)	REFID=52712
ADLER	98	PR D58 012003	R. Appel <i>et al.</i>	(BNL 865 Collab.)	REFID=47275
BATUSOV	98	NP B516 3	S. Adler <i>et al.</i>	(BNL E787 Collab.)	REFID=46050
DAMBROSIO	98A	JHEP 9808 004	V.Y. Batusov <i>et al.</i>		REFID=46044
ADLER	97	PRL 79 2204	G. D'Ambrosio <i>et al.</i>	(BNL E787 Collab.)	REFID=53689
ADLER	97C	PRL 79 4756	S. Adler <i>et al.</i>	(BNL E787 Collab.)	REFID=45597
BERGMAN	97	Theory, Yale Univ.	D.R. Bergman		REFID=45745
KITCHING	97	PRL 79 4079	P. Kitching <i>et al.</i>	(BNL E787 Collab.)	REFID=48055
PISLAK	97	Theory, Univ. Zurich	S. Pislak		REFID=45721
ADLER	96	PRL 76 1421	S. Adler <i>et al.</i>	(BNL E787 Collab.)	REFID=48056
KOPTEV	95	JETPL 61 877	V.P. Koptev <i>et al.</i>	(PNPI)	REFID=44723
		Translated from ZETFP 61 865.			REFID=44395

AOKI	94	PR D50 69	M. Aoki <i>et al.</i>	(INUS, KEK, TOKMS)	REFID=43863
ATIYA	93	PRL 70 2521	M.S. Atiya <i>et al.</i>	(BNL E787 Collab.)	REFID=43262
Also		PRL 71 305 (erratum)	M.S. Atiya <i>et al.</i>	(BNL E787 Collab.)	REFID=43449
ATIYA	93B	PR D48 R1	M.S. Atiya <i>et al.</i>	(BNL E787 Collab.)	REFID=43331
ALLIEGRO	92	PRL 68 278	C. Alliegro <i>et al.</i>	(BNL, FNAL, PSI+)	REFID=41961
BARMIN	92	SJNP 55 547	V.V. Barmin <i>et al.</i>	(ITEP)	REFID=42059
		Translated from YAF 55 976.			
IMAZATO	92	PRL 69 877	J. Imazato <i>et al.</i>	(KEK, INUS, TOKY+)	REFID=42141
IVANOV	92	THESIS	Yu.M. Ivanov	(PNPI)	REFID=43826
LITTENBERG	92	PRL 68 443	L.S. Littenberg, R.E. Shrock	(BNL, STON)	REFID=41823
USHER	92	PR D45 3961	T. Usher <i>et al.</i>	(UCI)	REFID=42070
AKIMENKO	91	PL B259 225	S.A. Akimenko <i>et al.</i>	(SERP, JINR, TBIL+)	REFID=41487
BARMIN	91	SJNP 53 606	V.V. Barmin <i>et al.</i>	(ITEP)	REFID=41593
		Translated from YAF 53 981.			
DENISOV	91	JETPL 54 558	A.S. Denisov <i>et al.</i>	(PNPI)	REFID=41935
Also		Translated from ZETFP 54 557.			
ATIYA	90	PRL 64 21	Yu.M. Ivanov	(PNPI)	REFID=43826
ATIYA	90B	PRL 65 1188	M.S. Atiya <i>et al.</i>	(BNL E787 Collab.)	REFID=40944
DEMIDOV	90	SJNP 52 1006	M.S. Atiya <i>et al.</i>	(BNL E787 Collab.)	REFID=41282
		Translated from YAF 52 1595.	(ITEP)	REFID=41491	
LEE	90	PRL 64 165	A.M. Lee <i>et al.</i>	(BNL, FNAL, VILL, WASH+)	REFID=41094
ATIYA	89	PRL 63 2177	M.S. Atiya <i>et al.</i>	(BNL E787 Collab.)	REFID=40947
BARMIN	89	SJNP 50 421	V.V. Barmin <i>et al.</i>	(ITEP)	REFID=41295
		Translated from YAF 50 679.			
BARMIN	88	SJNP 47 643	V.V. Barmin <i>et al.</i>	(ITEP)	REFID=40705
		Translated from YAF 47 1011.			
BARMIN	88B	SJNP 48 1032	V.V. Barmin <i>et al.</i>	(ITEP)	REFID=40868
		Translated from YAF 48 1719.			
BOLOTOV	88	JETPL 47 7	V.N. Bolotov <i>et al.</i>	(ASCI)	REFID=41494
		Translated from ZETFP 47 8.			
GALL	88	PRL 60 186	K.P. Gall <i>et al.</i>	(BOST, MIT, WILL, CIT+)	REFID=40289
BARMIN	87	SJNP 45 62	V.V. Barmin <i>et al.</i>	(ITEP)	REFID=40227
		Translated from YAF 45 97.			
BOLOTOV	87	SJNP 45 1023	V.N. Bolotov <i>et al.</i>	(INRM)	REFID=40415
		Translated from YAF 45 1652.			
AMENDOLIA	86B	PL B178 435	S.R. Amendolia <i>et al.</i>	(CERN NA7 Collab.)	REFID=48611
BOLOTOV	86	SJNP 44 73	V.N. Bolotov <i>et al.</i>	(INRM)	REFID=40225
		Translated from YAF 44 117.			
BOLOTOV	86B	SJNP 44 68	V.N. Bolotov <i>et al.</i>	(INRM)	REFID=40226
		Translated from YAF 44 108.			
YAMANAKA	86	PR D34 85	T. Yamanaka <i>et al.</i>	(KEK, TOKY)	REFID=11018
Also		PRL 52 329	R.S. Hayano <i>et al.</i>	(TOKY, KEK)	REFID=11019
AKIBA	85	PR D32 2911	Y. Akiba <i>et al.</i>	(TOKY, TINT, TSUK, KEK)	REFID=11016
BOLOTOV	85	JETPL 42 481	V.N. Bolotov <i>et al.</i>	(INRM)	REFID=11017
		Translated from ZETFP 42 390.			
ASANO	82	PL 113B 195	Y. Asano <i>et al.</i>	(KEK, TOKY, INUS, OSAK)	REFID=11013
COOPER	82	PL 112B 97	A.M. Cooper <i>et al.</i>	(RL)	REFID=10401
PDG	82B	PL 111B 70	M. Roos <i>et al.</i>	(HELS, CIT, CERN)	REFID=41156
ASANO	81B	PL 107B 159	Y. Asano <i>et al.</i>	(KEK, TOKY, INUS, OSAK)	REFID=11008
CAMPBELL	81	PRL 47 1032	M.K. Campbell <i>et al.</i>	(YALE, BNL)	REFID=11009
Also		PR D27 1056	S.R. Blatt <i>et al.</i>	(YALE, BNL)	REFID=11010
LUM	81	PR D23 2522	G.K. Lum <i>et al.</i>	(LBL, NBS+)	REFID=11011
LYONS	81	ZPHY C10 215	L. Lyons, C. Albajar, G. Myatt	(OXF)	REFID=11012
DALLY	80	PR 45 232	E.B. Dally <i>et al.</i>	(UCLA+)	REFID=48612
BARKOV	79	NP B148 53	L.M. Barkov <i>et al.</i>	(NOVO, KIAE)	REFID=11005
BLATNIK	79	LNC 24 39	S. Blatnik, J. Stahov, C.B. Lang	(TUZL, GRAZ)	REFID=48613
HEINTZE	79	NP B149 365	J. Heintze <i>et al.</i>	(HEIDP, CERN)	REFID=11006
ABRAMS	77	PR D15 22	R.J. Abrams <i>et al.</i>	(BNL)	REFID=11001
DEVAUX	77	NP B126 11	B. Devaux <i>et al.</i>	(SACL, GEVA)	REFID=11002
HEINTZE	77	PL 70B 482	J. Heintze <i>et al.</i>	(HEIDP, CERN)	REFID=11003
ROSSELET	77	PR D15 574	L. Rosselet <i>et al.</i>	(GEVA, SACL)	REFID=11004
BLOCH	76	PL 60B 393	P. Bloch <i>et al.</i>	(GEVA, SACL)	REFID=10995
BRAUN	76	LNC 17 521	H.M. Braun <i>et al.</i>	(AACH3, BARI, BELG+)	REFID=10996
DIAMANT-...	76	PL 62B 485	A.M. Diamant-Berger <i>et al.</i>	(SACL, GEVA)	REFID=10997
HEINTZE	76	PL 60B 302	J. Heintze <i>et al.</i>	(HEIDP)	REFID=10998
SMITH	76	NP B109 173	K.M. Smith <i>et al.</i>	(GLAS, LIVP, OXF+)	REFID=10999
WEISSENBE...	76	NP B115 55	A.O. Weissenberg <i>et al.</i>	(ITEP, LEBD)	REFID=11000
BLOCH	75	PL 56B 201	P. Bloch <i>et al.</i>	(SACL, GEVA)	REFID=10987
BRAUN	75	NP B89 210	H.M. Braun <i>et al.</i>	(AACH3, BARI, BRUX+)	REFID=10988
CHENG	75	NP A254 381	S.C. Cheng <i>et al.</i>	(COLU, YALE)	REFID=10989
HEARD	75	PL 55B 324	K.S. Heard <i>et al.</i>	(CERN, HEIDH)	REFID=10990
HEARD	75B	PL 55B 327	K.S. Heard <i>et al.</i>	(CERN, HEIDH)	REFID=10991
SHEAFF	75	PR D12 2570	M. Sheaff	(WISC)	REFID=10992
SMITH	75	NP B91 45	K.M. Smith <i>et al.</i>	(GLAS, LIVP, OXF+)	REFID=10993
WEISSENBE...	74	PL 48B 474	A.O. Weissenberg <i>et al.</i>	(ITEP, LEBD)	REFID=10986
ABRAMS	73B	PRL 30 500	R.J. Abrams <i>et al.</i>	(BNL)	REFID=10963
BACKENSTO...	73	PL 43B 431	G. Backenstoss <i>et al.</i>	(CERN, KARLK, KARLE+)	REFID=10964
LJUNG	73	PR D8 1307	D. Ljung, D. Cline	(WISC)	REFID=10971
Also		PRL 28 523	D. Ljung	(WISC)	REFID=10972
Also		PRL 28 1287	D. Cline, D. Ljung	(WISC)	REFID=10973
Also		PRL 23 326	U. Camerini <i>et al.</i>	(WISC)	REFID=10974
LUCAS	73	PR D8 719	P.W. Lucas, H.D. Taft, W.J. Willis	(YALE)	REFID=10975
LUCAS	73B	PR D8 727	P.W. Lucas, H.D. Taft, W.J. Willis	(YALE)	REFID=10976
PANG	73	PR D8 1989	C.Y. Pang <i>et al.</i>	(EFI, ARIZ, LBL)	REFID=10977
Also		PL 40B 699	G.D. Cable <i>et al.</i>	(EFI, LBL)	REFID=10978
SMITH	73	NP B60 411	K.M. Smith <i>et al.</i>	(GLAS, LIVP, OXF+)	REFID=10979
ABRAMS	72	PRL 29 1118	R.J. Abrams <i>et al.</i>	(BNL)	REFID=10954
AUBERT	72	NC 12A 509	B. Aubert <i>et al.</i>	(ORSAY, BRUX, EPOL)	REFID=10956
CHIANG	72	PR D6 1254	I.H. Chiang <i>et al.</i>	(ROCH, WISC)	REFID=10958
CLARK	72	PRL 29 1274	A.R. Clark <i>et al.</i>	(LBL)	REFID=10959
FORD	72	PL 38B 335	W.T. Ford <i>et al.</i>	(PRIN)	REFID=10961
HOFFMASTER	72	NP B36 1	S. Hoffmaster <i>et al.</i>	(STEV, SETO, LEHI)	REFID=10962
BOURQUIN	71	PL 36B 615	M.H. Bourquin <i>et al.</i>	(GEVA, SACL)	REFID=10943
HAIDT	71	PR D3 10	D. Haidt <i>et al.</i>	(AACH, BARI, CERN, EPOL, NIJM+)	REFID=10911
Also		PL 29B 691	D. Haidt <i>et al.</i>	(AACH, BARI, CERN, EPOL+)	REFID=10945
KLEMS	71	PR D4 66	J.H. Klems, R.H. Hildebrand, R. Stiening	(CHIC+)	REFID=10946
Also		PRL 24 1086	J.H. Klems, R.H. Hildebrand, R. Stiening	(LRL+)	REFID=10947
Also		PRL 25 473	J.H. Klems, R.H. Hildebrand, R. Stiening	(LRL+)	REFID=10948

OTT	71	PR D3 52	R.J. Ott, T.W. Pritchard	(LOQM)	REFID=10950
ROMANO	71	PL 36B 525	F. Romano et al.	(BARI, CERN, ORSAY)	REFID=10951
SCHWEINBERG	71	PL 36B 246	W. Schweinberger	(AACH, BELG, CERN, NIJM+)	REFID=10952
STEINER	71	PL 36B 521	H.J. Steiner	(AACH, BARI, CERN, EPOL, ORSAY+)	REFID=10953
BARDIN	70	PL 32B 121	D.Y. Bardin, S.N. Bilenky, B.M. Pontecorvo	(JINR)	REFID=11032
BECHERRAWY	70	PR D1 1452	T. Becherrawy	(ROCH)	REFID=11033
FORD	70	PRL 25 1370	W.T. Ford et al.	(PRIN)	REFID=10936
GAILLARD	70	CERN 70-14	J.M. Gaillard, L.M. Chouinet	(CERN, ORSAY)	REFID=11035
GRAUMAN	70	PR D1 1277	J. Grauman et al.	(STEV, SETO, LEHI)	REFID=10937
Also		PRL 23 737	J.U. Grauman et al.	(STEV, SETO, LEHI)	REFID=10938
PANDOULAS	70	PR D2 1205	D. Pandoulas et al.	(STEV, SETO)	REFID=10941
CUTTS	69	PR 184 1380	D. Cutts et al.	(LRL, MIT)	REFID=10923
Also		PRL 20 955	D. Cutts et al.	(LRL, MIT)	REFID=10924
DAVISON	69	PR 180 1333	D.C. Davison et al.	(UCR)	REFID=10925
ELY	69	PR 180 1319	R.P.J. Ely et al.	(LOUC, WISC, LRL)	REFID=10926
HERZO	69	PR 186 1403	D. Herzo et al.	(ILL)	REFID=10928
LOBKOWICZ	69	PR 185 1676	F. Lobkowicz et al.	(ROCH, BNL)	REFID=10930
Also		PRL 17 548	F. Lobkowicz et al.	(ROCH, BNL)	REFID=10645
MAST	69	PR 183 1200	T.S. Mast et al.	(LRL)	REFID=10933
SELLERI	69	NC 60A 291	F. Selleri		REFID=41165
ZELLER	69	PR 182 1420	M.E. Zeller et al.	(UCLA, LRL)	REFID=10934
BOTTERILL	68B	PRL 21 766	D.R. Botterill et al.	(OXF)	REFID=10914
BOTTERILL	68C	PR 174 1661	D.R. Botterill et al.	(OXF)	REFID=10913
BUTLER	68	UCRL 18420	W.D. Butler et al.	(LRL)	REFID=10915
CHANG	68	PRL 20 510	C.Y. Chang et al.	(UMD, RUTG)	REFID=10916
CHEN	68	PRL 20 73	M. Chen et al.	(LRL, MIT)	REFID=10917
EICHEN	68	PL 27B 586	T. Eichten	(AACH, BARI, CERN, EPOL, ORSAY+)	REFID=10918
ESCHSTRUTH	68	PR 165 1487	P.T. Eschstruth et al.	(PRIN, PENN)	REFID=10920
GARLAND	68	PR 167 1225	R. Garland et al.	(COLU, RUTG, WISC)	REFID=10921
MOSCOSO	68	Thesis	L. Moscoso	(ORSAY)	REFID=10922
AUERBACH	67	PR 155 1505	L.B. Auerbach et al.	(PENN, PRIN)	REFID=10893
Also		PR D9 3216	L.B. Auerbach		REFID=10895
Erratum.					
BELLOTTI	67	Heidelberg Conf.	E. Bellotti, A. Pullia	(MILA)	REFID=10896
BELLOTTI	67B	NC 52A 1287	E. Bellotti, E. Fiorini, A. Pullia	(MILA)	REFID=10897
Also		PL 20 690	E. Bellotti et al.	(MILA)	REFID=10898
BISI	67	PL 25B 572	V. Bisi et al.	(TORI)	REFID=10899
FLETCHER	67	PRL 19 98	C.R. Fletcher et al.	(ILL)	REFID=10905
FORD	67	PRL 18 1214	W.T. Ford et al.	(PRIN)	REFID=10906
GINSBERG	67	PR 162 1570	E.S. Ginsberg	(MASB)	REFID=11028
KALMUS	67	PR 159 1187	G.E. Kalmus, A. Kernan	(LRL)	REFID=10908
ZINCHENKO	67	Thesis Rutgers	A.I. Zinchenko	(RUTG)	REFID=10909
CALLAHAN	66	NC 44A 90	A.C. Callahan	(WISC)	REFID=10891
CALLAHAN	66B	PR 150 1153	A.C. Callahan et al.	(WISC, LRL, UCR+)	REFID=10890
CESTER	66	PL 21 343	R. Cester et al.	(PPA)	REFID=10892
See footnote 1 in AUERBACH 67.					
Also		PR 155 1505	L.B. Auerbach et al.	(PENN, PRIN)	REFID=10893
BIRGE	65	PR 139 B1600	R.W. Birge et al.	(LRL, WISC)	REFID=10875
BISI	65	NC 35 768	V. Bisi et al.	(TORI)	REFID=10876
BISI	65B	PR 139 B1068	V. Bisi et al.	(TORI)	REFID=10877
CALLAHAN	65	PRL 15 129	A. Callahan, D. Cline	(WISC)	REFID=10879
CLINE	65	PL 15 293	D. Cline, W.F. Fry	(WISC)	REFID=10881
DEMARCO	65	PR 140B 1430	A. de Marco, C. Grosso, G. Rinaudo	(TORI, CERN)	REFID=10883
FITCH	65B	PR 140B 1088	V.L. Fitch, C.A. Quarles, H.C. Wilkins	(PRIN+)	REFID=10884
STAMER	65	PR 138 B440	P. Stamer et al.	(STEV)	REFID=10886
YOUNG	65	Thesis UCRL 16362	P.S. Young	(LRL)	REFID=10888
Also		PR 156 1464	P.S. Young, W.Z. Osborne, W.H. Barkas	(LRL)	REFID=10889
BORREANI	64	PL 12 123	G. Borreani, G. Rinaudo, A.E. Werbrouck	(TORI)	REFID=10866
CALLAHAN	64	PR 136 B1463	A. Callahan, R. March, R. Stark	(WISC)	REFID=10867
GREINER	64	PRL 13 284	D.E. Greiner, W.Z. Osborne, W.H. Barkas	(LRL)	REFID=40183
SHAKLEE	64	PR 136 B1423	F.S. Shaklee et al.	(MICH)	REFID=10874
BOYARSKI	62	PR 128 2398	A.M. Boyarski et al.	(MIT)	REFID=10863
FERRO-LUZZI	61	NC 22 1087	M. Ferro-Luzzi et al.	(LRL)	REFID=10860
ROE	61	PRL 7 346	B.P. Roe et al.	(MICH, LRL)	REFID=10862
TAYLOR	59	PR 114 359	S. Taylor et al.	(COLU)	REFID=10856
COOMBES	57	PR 108 1348	C.A. Coombes et al.	(LBL)	REFID=10853

OTHER RELATED PAPERS

LITTENBERG	93	ARNPS 43 729	L.S. Littenberg, G. Valencia	(BNL, FNAL)	REFID=43652
Rare and Radiative Kaon Decays					
RITCHIE	93	RMP 65 1149	J.L. Ritchie, S.G. Wojcicki		REFID=43622
"Rare K Decays"					
BATTISTON	92	PRPL 214 293	R. Battiston et al.	(PGIA, CERN, TRSTT)	REFID=42063
Status and Perspectives of K Decay Physics					
BRYMAN	89	IJMP A4 79	D.A. Bryman	(TRIU)	REFID=40709
"Rare Kaon Decays"					
CHOUNET	72	PRPL 4C 199	L.M. Chouinet, J.M. Gaillard, M.K. Gaillard	(ORSAY+)	REFID=11038
FEARING	70	PR D2 542	H.W. Fearing, E. Fischbach, J. Smith	(STON, BOHR)	REFID=11034
HAIDT	69B	PL 29B 696	D. Haidt et al.	(AACH, BARI, CERN, EPOL+)	REFID=11031
CRONIN	68B	Vienna Conf. 241	J.W. Cronin	(PRIN)	REFID=11030
Rapporteur talk.					
WILLIS	67	Heidelberg Conf. 273	W.J. Willis	(YALE)	REFID=11029
Rapporteur talk.					
CABIBBO	66	Berkeley Conf. 33	N. Cabibbo	(CERN)	REFID=11027
ADAIR	64	PL 12 67	R.K. Adair, L.B. Leipuner	(YALE, BNL)	REFID=11023
CABIBBO	64	PL 9 352	N. Cabibbo, A. Maksymowicz	(CERN)	REFID=11024
Also		PL 11 360	N. Cabibbo, A. Maksymowicz	(CERN)	REFID=11025
Also		PL 14 72	N. Cabibbo, A. Maksymowicz	(CERN)	REFID=11026
BIRGE	63	PRL 11 35	R.W. Birge et al.	(LRL, WISC, BARI)	REFID=11022
BLOCK	62B	CERN Conf. 371	M.M. Block, L. Lendinara, L. Monari	(NWES, BGNA)	REFID=11020
BRENE	61	NP 22 553	N. Brene, L. Egardt, B. Qvist	(NORD)	REFID=11021
